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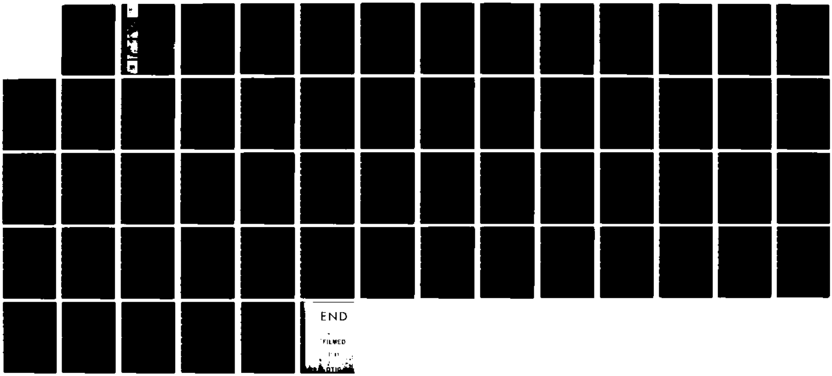

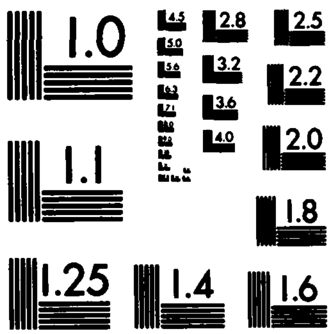

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COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

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USER'S GUIDE: COMPUTER PROGRAM TO CALCULATE SHEAR, MOMENT, AND THRUST (CSMT) FROM STRESS RESULTS OF A TWO-DIMENSIONAL FINITE ELEMENT ANALYSIS

by

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US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

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Final Report

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

CSMT (Computer program)
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Finite element method
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Structural analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The program CSMT calculates shear, moment, and thrust for sections of a structure specified by the user, from stress results of a two-dimensional finite element (FE) analysis.

The bulk of the input is for geometry definition (node and element data) and the stress results from a FE analysis. The node and element data are read free-field from one data file, and the stresses are read from another file. The remaining data are interactive commands to specify section information and to

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20. ABSTRACT (Continued).

cont obtain plots of grid, sections, and results (shear, moment, and thrust).

Preface

This report is a user's guide for computer program CSMT which can be used to calculate shear, moment, and thrust for a given structure section from stress results of a two-dimensional finite element analysis. The work in writing the program and this user's guide was accomplished with funds provided to the Automatic Data Processing (ADP) Center, U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., by the Engineering and Construction Directorate (ECD) of the Office, Chief of Engineers, U. S. Army (OCE), under the Computer-Aided Structural Engineering (CASE) Project.

Specifications for the program were prepared by members of the CASE Task Group on the Finite Element Method of Analysis. Members of the task group during the period of development of the program were as follows:

Mr. Tom McGee, Nashville District (Chairman until February 1983)
Mr. Dave Raisanen, North Pacific Division (Current Chairman)
Mr. Rich Flauaus, St. Louis District
Mr. Dick Huff, Kansas City District
Mr. Paul LaHoud, Huntsville Division
Mr. Ed Alling, U. S. Soil Conservation Service
Mr. Jerry Foster, Federal Energy Regulatory Commission
Mr. Paul Noyes, Seattle District (joined in May 1983)
Mr. Lucian Guthrie, OCE
Mr. Robert L. Hall, WES
Dr. N. Radhakrishnan, WES

The program and this report were written by Mr. Fred T. Tracy, Chief, Research and Development Software (RADS) Group, ADP Center, WES; Mr. Robert L. Hall, Computer-Aided Design (CAD) Group, ADP Center; and Mr. Kenneth W. Trahan, summer student with the RADS Group. Initial guild line for input data was provided by Mr. H. Wayne Jones, CAD Group. The work was managed and coordinated by Dr. Radhakrishnan, Special Technical Assistant, ADP Center, and CASE Project Manager. Mr. Lucian Guthrie, Structures Branch, ECD, was the OCE point of contact.

Commander and Director of WES during development of the program and preparation and publication of this report was COL Tilford C. Creel, CE. Technical Director was Mr. F. R. Brown.

Contents

Conversion Factors, Non-SI to SI (Metric) Units of Measurement

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
feet	0.3048	meters
kip (1000 lb mass)-feet	138.255	kilogram-meters
pound (mass)-feet	0.138255	kilogram-meters
pounds (force)	4.448222	newtons
pounds (force) per square inch	6.894757	kilopascals

USER'S GUIDE: COMPUTER PROGRAM TO CALCULATE SHEAR, MOMENT, AND THRUST (CSMT) FROM STRESS RESULTS OF A TWO-DIMENSIONAL FINITE ELEMENT ANALYSIS

Purpose

1. The purpose of program CSMT* is to calculate shear, moment, and thrust, for sections of a structure specified by the user, from stress results of a two-dimensional finite element (FE) analysis.

Program Details

Input

2. The bulk of the input is for geometry definition (node and element data) and the stress results from a FE analysis. The node and element data are read free-field from one data file, and the stresses are read from another file. The remaining data are interactive commands to specify section information and to obtain grid, section, and output plots.

Geometry data

3. The geometry data are read free-field from a line-numbered data file. The data consist of the node and element data which define the FE grid. Thus, the (X,Y) coordinates for each node and the node numbers for each element are required. Figure 1 shows the exact data file format. Note that elements may be 4- or 8-node quadrilaterals.

Triangular elements

4. Triangular elements are input by collapsing one side of a quadrilateral to a point. Figure 2 shows 3- and 6-node triangular elements and the corresponding element data. It should be noted that all input is the same for either quadrilateral or triangular elements.

---

* CSMT is designated X0063 in the Conversationally Oriented Real-Time Program-Generating System (CORPS) library. Three sheets entitled "Program Information" have been hand-inserted inside the front cover of this report. They present general information on the program and describe how it can be accessed. If procedures used to access this and other CORPS library programs should change, recipients of this report will be furnished a revised version of the "Program Information."

LN	NNP	NEL	NNELE	NMATP						CONTROL DATA
LN	1	X(1)	Y(1)							
.	.	.	.							
.	.	.	.							NODE DATA
.	.	.	.							
LN	NNP	X(NNP)	Y(NNP)							
LN 1	I(1)	J(1)	K(1)	L(1)	I1(1)	JI(1)	KI(1)	LI(1)	M(1)	
.	.	.	.	.	.	.	.	.	.	ELEMENT DATA
.	.	.	.	.	.	.	.	.	.	
.	.	.	.	.	.	.	.	.	.	
LN NEL	I(NEL)	J(NEL)	K(NEL)	L(NEL)	I1(NEL)	J1(NEL)	K1(NEL)	L1(NEL)	M(NEL)	

LN = line number

NNP = total number of nodes in grid

NEL = total number of elements in grid

NNELE = number of nodes per element (4 or 8)

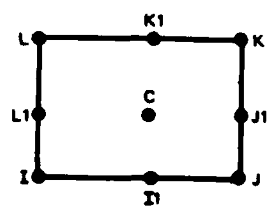
NMATP = number of material properties

X(N) = X coordinates of node N

Y(N) = Y coordinates of node N

M(N) = material type for element N

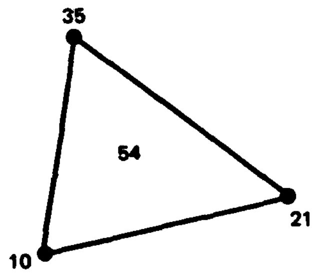
I(N)
J(N)
K(N)
L(N) = corner nodes of an element



I1(N)
J1(N)
K1(N)
L1(N) = midside element nodes (necessary only if NNELE = 8)

Note: Node and element data must be in ascending order.

Figure 1. Geometry data file format

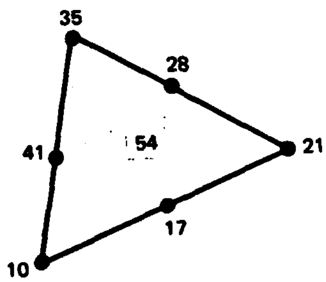


Element Data:

NEL	I	J	K	L	MAT
54	10	21	35	35	1

Material Type = 1

a. 3-node triangular element



Element Data:

NEL	I	J	K	L	I1	J1	K1	L1	MAT
54	10	21	35	35	17	28	35	41	1

Material Type = 1

b. 6-node triangular element

Figure 2. Triangular elements

Global stress data

5. The global stress data are also read free-field from a line-numbered data file. These data consist of the σ_x , σ_y , and τ_{xy} stresses. These stresses may be available at different locations in an element depending upon the FE program used and the type of element. To accommodate the various programs, program CSMT accepts the following options for computing stresses:

a. At the "center" of each element--Type = 0.

b. At each node (an average value for all elements meeting at a node)--Type = 1.

c. At each node for every element (as many values at a node as the number of elements meeting at the node)--Type = 2.

d. At each midside and "center" for each element (for 4-node elements only)--Type = 3.

Figure 3 shows the exact data file format. The "center" of an element is assumed to be at the coordinates $s = 0$, $t = 0$ for a parametric coordinate system.

Interactive Commands

6. Interactive commands are provided to give the user flexibility in defining those sections along which moments, shears, and thrusts need to be calculated and in obtaining output. These commands are:

a. SECTION. Define a section.

b. PLOT. Plot the grid and/or section.

c. WINDOW. Do a window plot.

d. OUTPUT. Display output for a section.

e. END. End running the program.

Because all the commands start with a different letter, only the first letter of a command need be input. However, the user may use as many of the letters as desired.

SECTION

7. The general form for this command is:

```
SECTION I, X1, Y1, X2, Y2, M
```

This command allows the user to define the Ith section where shear, moment, and thrust calculations are desired by defining two points, (X1, Y1) and (X2, Y2), representing the beginning and ending points of the section. The M

LN	TYPE	TC	Control Data

STRESSES FOR TYPE = 0

LN	SX(1)	SY(1)	SXY(1)
.	.	.	.
.	.	.	.
.	.	.	.
LN	SX(NEL)	SY(NEL)	SXY(NEL)

STRESSES FOR TYPE = 1

LN	SX(1)	SY(1)	SXY(1)
.	.	.	.
.	.	.	.
.	.	.	.
LN	SX(NNP)	SY(NNP)	SXY(NNP)

STRESSES FOR TYPE = 2, NNELE = 4

	LN	SX(I)	SY(I)	SXY(I)
ELEMENT	LN	SX(J)	SY(J)	SXY(J)
1	LN	SX(K)	SY(K)	SXY(K)
	LN	SX(L)	SY(L)	SXY(L)
	.	.	.	.
	.	.	.	.
	.	.	.	.
	.	.	.	.
	.	.	.	.
ELEMENT	LN	SX(I)	SY(I)	SXY(I)
NEL	LN	SX(J)	SY(J)	SXY(J)
	LN	SX(K)	SY(K)	SXY(K)
	LN	SX(L)	SY(L)	SXY(L)

Figure 3. Stress data file format (Continued)

STRESSES FOR TYPE = 2, NNELE = 8

ELEMENT	LN	SX(I)	SY(I)	SXY(I)
1	LN	SX(J)	SY(J)	SXY(J)
	LN	SX(K)	SY(K)	SXY(K)
	LN	SX(L)	SY(L)	SXY(L)
	LN	SX(I1)	SY(I1)	SXY(I1)
	LN	SX(J1)	SY(J1)	SXY(J1)
	LN	SX(K1)	SY(K1)	SXY(K1)
	LN	SX(L1)	SY(L1)	SXY(L1)
	.			
	.			
	.			
ELEMENT	LN	SX(I)	SY(I)	SXY(I)
NEL	LN	SX(J)	SY(J)	SXY(J)
	LN	SX(K)	SY(K)	SXY(K)
	LN	SX(L)	SY(L)	SXY(L)
	LN	SX(I1)	SY(I1)	SXY(I1)
	LN	SX(J1)	SY(J1)	SXY(J1)
	LN	SX(K1)	SY(K1)	SXY(K1)
	LN	SX(L1)	SY(L1)	SXY(L1)

STRESSES FOR TYPE = 3

	LN	SX(C)	SY(C)	SXY(C)
	LN	SX(M1)	SY(M1)	SXY(M1)
ELEMENT	LN	SX(M2)	SY(M2)	SXY(M2)
1	LN	SX(M3)	SY(M3)	SXY(M3)
	LN	SX(M4)	SY(M4)	SXY(M4)
	LN	SX(C)	SY(C)	SXY(C)
	LN	SX(M1)	SY(M1)	SXY(M1)
ELEMENT	LN	SX(M2)	SY(M2)	SXY(M2)
NEL	LN	SX(M3)	SY(M3)	SXY(M3)
	LN	SX(M4)	SY(M4)	SXY(M4)

Where TYPE = 0 for stresses given at element centers
= 1 for stresses given at nodal points (average values at nodes)
= 2 for stresses given at nodal points for each element
= 3 for stresses given at element centers
and at midsides for each element (4-node elements only)

TC = 1 positive stresses are tension
= 0 positive stresses are compression
SX = global X stress
SY = global Y stress
SXY = global XY stress
NEL = number of elements
NNELE = number of nodes per element (4 or 8)
NNP = number of nodal points
LN = line number
C = center
M1,M2,M3,M4 = midside positions halfway between respective corner nodes

Figure 3. (Concluded)

allows the user to select an individual material property for the calculations. All input values are optional except for the section number I. Thus, there are four specific forms of the command:

SECTION I, X1, Y1, X2, Y2, M (Form 1)
SECTION I, X1, Y1, X2, Y2 (Form 2)
SECTION I, M (Form 3)
SECTION I (Form 4)

8. Form 1 requires the user to enter six values (section number, X1 coordinate, Y1 coordinate, X2 coordinate, Y2 coordinate, and material property). The calculations are based only on the stresses from (X1, Y1) to (X2, Y2) with elements having a material property of M. (Stresses from elements whose material property is not "M" are omitted in calculating the results.)

9. Form 2 requires the user to enter five values. The material property is omitted, and the calculations are based on all stresses from (X1, Y1) to (X2, Y2).

10. Form 3 requires the user to enter two values (section number and material property). The coordinates of (X1, Y1) and (X2, Y2) are set by the user with the cross hairs on the graphics terminal. Again, the calculations are based on the stresses produced by elements having a material property which corresponds to M.

11. Form 4 requires the user to enter only the section number. The coordinates of (X1, Y1) and (X2, Y2) are set by the user with the cross hairs on the graphics terminal. The shear, moment, and thrust calculations are based on all stresses across the selected section.

12. If X1, Y1, X2, and Y2 are not given with the SECTION command, the cross hairs appear for the user to first pick (X1, Y1). After the cross hairs appear, the thumb wheels on the graphics terminal can be used to move the cross hairs to the location of (X1, Y1). After the user types any character (and possibly a carriage return, depending on how the terminal is set up), the cross hairs reappear so this process can be repeated for (X2, Y2). The grid or a window of the grid must first be displayed before the cross hairs options can be used. The program reorders points (X1, Y1) and (X2, Y2) so that the first point (X1, Y1) is lower than the second point (X2, Y2). For a horizontal line, the first point is to the left of the second point. When the section is plotted, the first point is always the lowest point.

PLOT

13. This command has two options:

PLOT GRID

PLOT SECTION I

The first command allows the user to plot the FE grid. The second plots the Nth section. As many sections as are defined can be plotted. If I is not specified, all the sections currently defined will be plotted.

WINDOW

14. This command allows the user to obtain a magnified view of a rectangular portion of the grid by defining a window. After typing the command, the cross hairs appear for the user to select the lower, left-hand corner of the window. After selection, the user types any character and a carriage return. The cross hairs then reappear so the process can be repeated for the upper right-hand corner of the window. Afterward, the window is then plotted.

OUTPUT

15. The command is for displaying the normal stress, thrust, bending stress, and shear stress on one plot. This command is also given to display each stress distribution plot individually with the maximum and minimum stress values displayed.

16. The form for the combined plot is

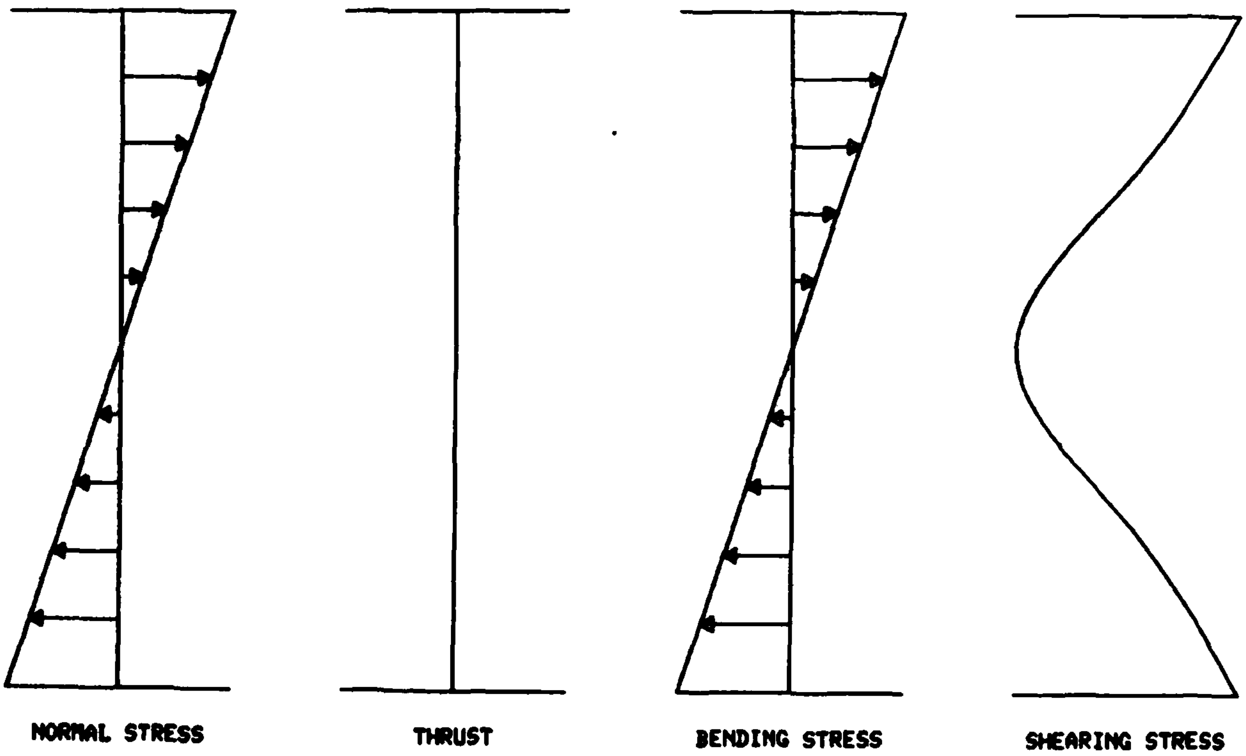
OUTPUT I

where I is the section number. This command allows the user to plot the stress distribution and resulting shear, moment, and thrust for the Nth specified section. Figure 4 shows a sample plot. The user is given the following message if an incorrect section number is given:

SECTION NOT DEFINED

17. The form for individual stress plots is

OUTPUT	NORMAL STRESS	I
	THRUST	
	BENDING STRESS	
	SHEAR STRESS	



(X1, Y1) = (32.,0.)
(X2, Y2) = (32.,10.)
NEUTRAL AXIS = (32.,5.)
SHEAR = -9995.
MOMENT = -.6145E+6
THRUST = 0.

SECTION NO. 1

Figure 4. Section output plot

where I is the optional section number. If I is not given, the selected stress distribution will be given for the last section displayed. The following command was used to generate Figure 5:

OUTPUT I 1

<u>END</u>

18. This command terminates the program.

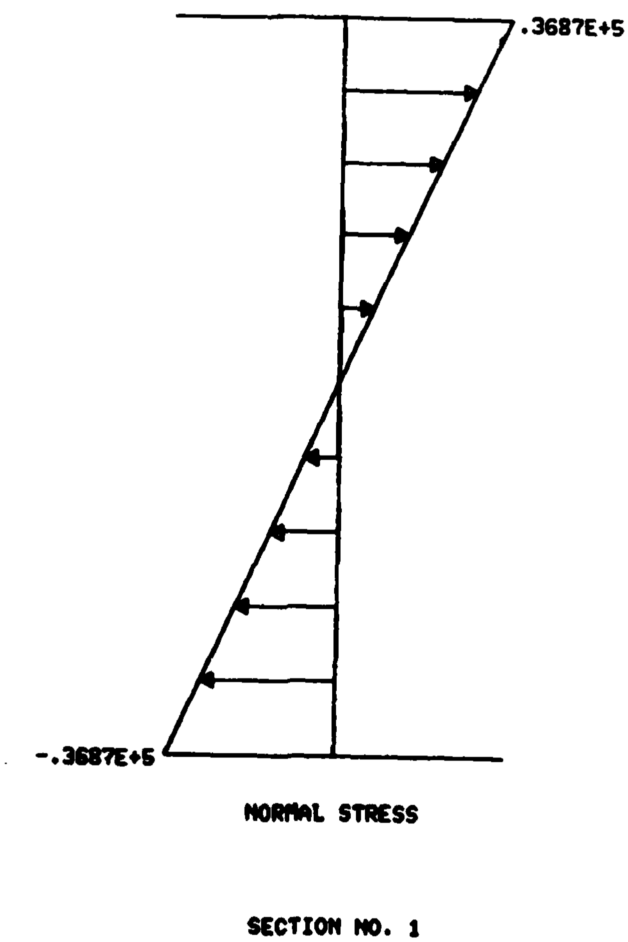


Figure 5. Normal stress plot

File Output

19. For each section defined, two lines of data are written to a permanent disc file. The first line of data contains the section number and the

(X1, Y1), (X2, Y2), and (XN, YN) coordinates representing where the neutral axis intersects the section. The second line contains the values of shear, moment, and thrust. See Appendix B for an example display of an output file.

Sample Run

20. Appendix A gives a step-by-step example on the use of program CSMT. It shows uses of every command but does not demonstrate every form of each command.

Caution in Use of the Program

21. The obvious use for this program is to calculate the shear, moment, and thrust along a given section based on output from a FE analysis. The user needs to remember that the FE method is an approximate procedure that first computes displacements and then stresses. These stresses can be crude if an adequate mesh is not used in the analysis. CSMT calculates shear, moment, and thrust along a section based on interpolation of the computed discrete stress values. Because of these assumptions, equilibrium may not be satisfied, particularly when sections are taken in areas of high stress gradients and especially when a coarse grid is used. Results from CSMT at points where loads have been applied will be of little value.

22. As the grid in areas with high stress gradients becomes finer, results from CSMT will more closely satisfy equilibrium. In reality, CSMT can be used in determining the validity of a FE analysis by comparing computed values with those required for equilibrium.

Theory and Procedure

23. The technique used to compute shear, moment, and thrust along a section is as follows:

- a. Compute the principal X and Y stresses and shearing stress (σ_x , σ_y , τ_{xy}) at the nodes and, when needed, at the centers of the elements.
- b. Compute these stresses by interpolation at points along the given section where it intersects the grid.

c. Transform the stresses to a new coordinate system with the new Y axis parallel to the section.

d. Compute thrust and shear using numerical integration.

e. Compute the bending stress.

f. Compute the neutral axis.

g. Compute the moment.

Stresses at the nodes and centers

24. The first step in the computation process is to determine single values of normal X and Y stresses and shear stress (σ_x , σ_y , and τ_{xy}) for each node of the grid. For 8-node elements, the stresses at the centers of the elements are also required.

25. TYPE = 0, NNELE = 4. For TYPE = 0, the stresses are known at the center and must be computed at the nodes. Each of the three stresses are computed in the same way; the stress σ at node N (Figure 6) is computed from

$$\sigma_N = \frac{\sum_{i=1}^{4} \frac{\sigma_i}{\left(X_i - X_N\right)^2 + \left(Y_i - Y_N\right)^2}}{\sum_{i=1}^{4} \frac{1}{\left(X_i - X_N\right)^2 + \left(Y_i - Y_N\right)^2}} \tag{1}$$

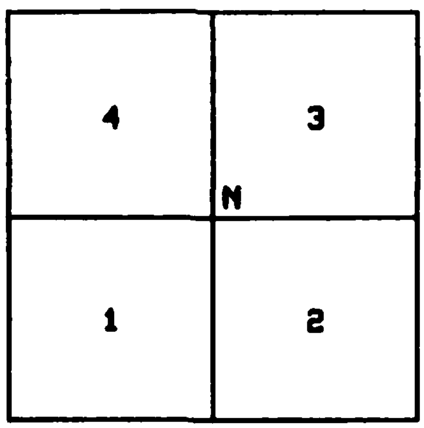


Figure 6., Sample grid

Here, X_i , Y_i , and σ_i represent the coordinates and stress, respectively, at center i . This is the familiar inverse distance squared interpolation formula. The summation (1 to 4 here) is in general from 1 to the number of elements surrounding a node.

26. TYPE = 0, NNELE = 8. The procedure is the same as above, except that the stresses at the midside nodes must also be computed.

27. TYPE = 1, NNELE = 4. The stresses are input for the nodes and are not needed for the elements, so no computation is necessary.

28. TYPE = 1, NNELE = 8. The stresses are input for the nodes, but the stresses at the centers need to be computed. The isoparametric element formulation is used and at $s = 0$, $t = 0$ reduces to (see Figure 7)

$$\sigma_c = \frac{1}{2} \sum_{i=5}^{8} \sigma_i - \frac{1}{4} \sum_{i=1}^{4} \sigma_i \tag{2}$$

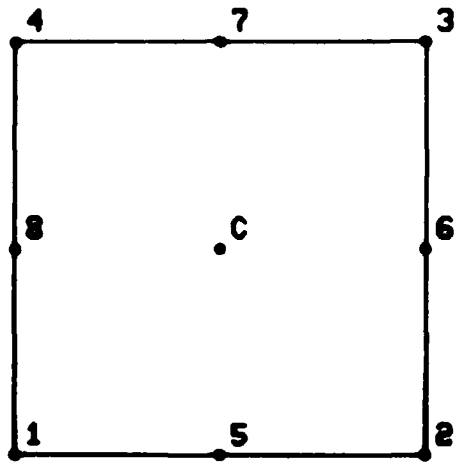


Figure 7. Grid system for 8-node element

29. TYPE = 2, NNELE = 4. This type has as input a stress for each node from each element. All the different values are simply averaged at a given node to determine a single . Stress values at the center are not needed.

30. TYPE = 2, NNELE = 8. The stresses at the nodes are computed by the same averaging process described for NNELE = 4. The stress at the center of an element is computed using Equation 2 and the stress values given for that element.

31. TYPE = 3, NNELE = 4. The stress values at the center and midside

positions are given for each element. The program treats the grid as if NNELE = 8. Thus, node numbers for the midside nodes are generated, and the element data are modified to reflect 8 nodes per element. The stress values at the midside nodes are computed using a simple average of the contribution from each element. Equation 1 is used to compute the stress values at the corner nodes with the midside nodes only being used in the summation (see Figure 8).

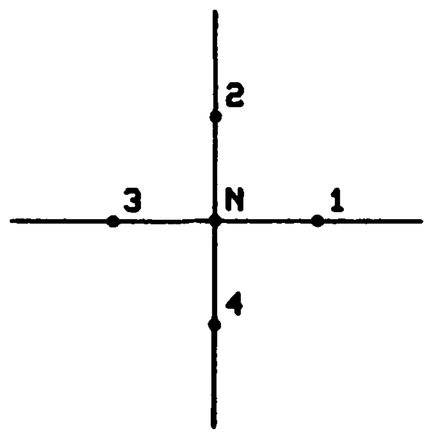


Figure 8. Corner node computation

Stresses along the section

32. The next step in the calculation procedure is to compute stress values at points along the section. The points used are those that intersect the grid system. Figure 9 shows the grid system used for TYPE = 0, NNELE = 4, and Figure 10 shows the grid system for TYPE = 1, 2, NNELE = 4. For TYPE = 3, NNELE = 4, and for all TYPE values for NNELE = 8, the grid system shown in Figure 11 is used. The coordinates and stress values along the section are computed using linear interpolation.

New coordinate system

33. Next, the coordinate system is rotated such that the Y' axis is parallel to the section, and the X' axis is perpendicular to the section (see Figure 12). The (X, Y) coordinates are transformed by

$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \begin{bmatrix} \cos A & \sin A \\ -\sin A & \cos A \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} \qquad (3)$$

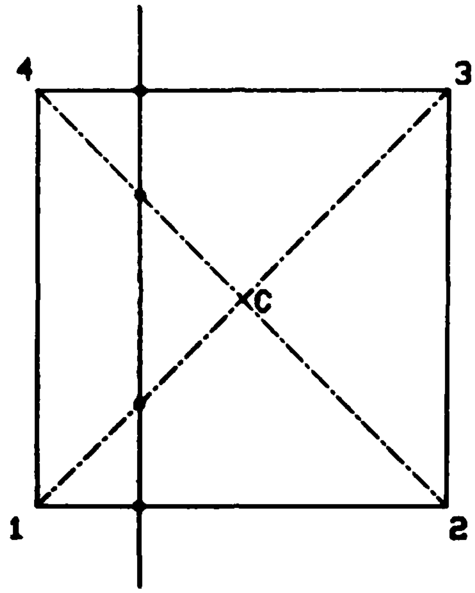


Figure 9. Grid system for TYPE = 0,
NNELE = 4

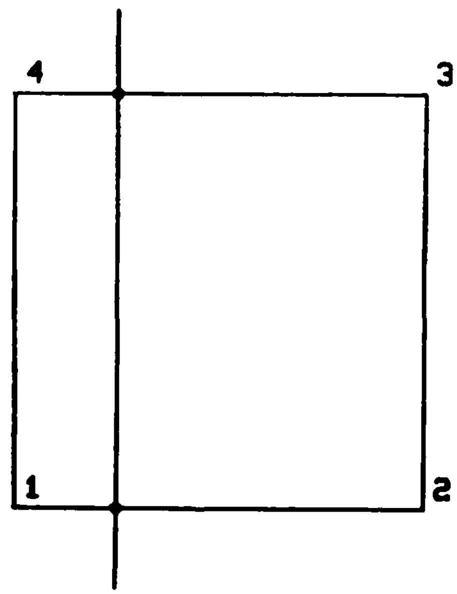


Figure 10. Grid system for TYPE = 1,
2, NNELE = 4

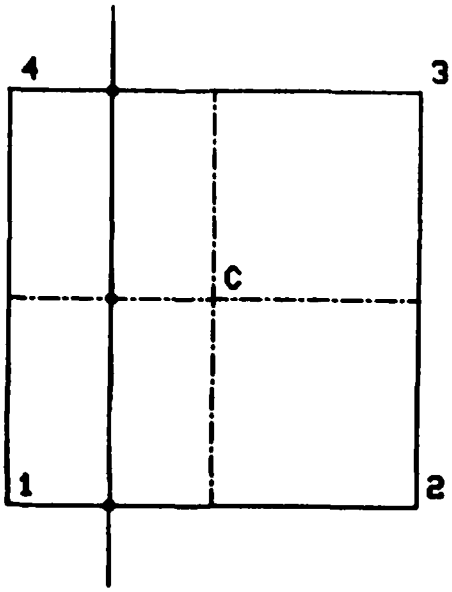


Figure 11. Grid system for TYPE = 3, NNELE = 4, and for all TYPE values for NNELE = 8

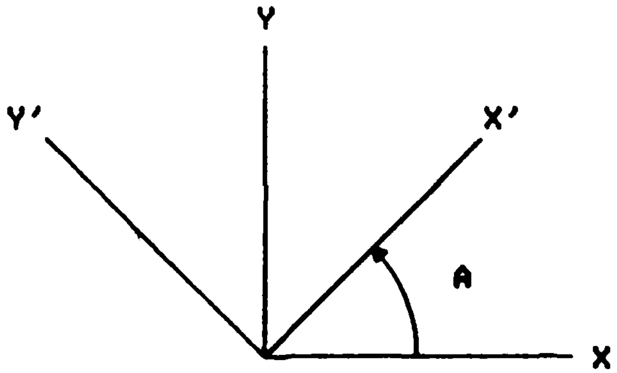


Figure 12. New coordinate system

The stresses are transformed by

$$\begin{bmatrix} \sigma'_x & \tau'_{xy} \\ \tau'_{xy} & \sigma'_y \end{bmatrix} = \begin{bmatrix} \cos A & \sin A \\ -\sin A & \cos A \end{bmatrix} \begin{bmatrix} \sigma_x & \tau_{xy} \\ \tau_{xy} & \sigma_y \end{bmatrix} \begin{bmatrix} \cos A & -\sin A \\ \sin A & \cos A \end{bmatrix} \tag{4}$$

The angle A is computed such that its maximum absolute value is 90 deg. A horizontal segment has A = 90 deg.

Spline fit

34. There now are three sets of data (Y', σ'_x), (Y', σ'_y), and (Y', τ_{xy}), along the section. These are first sorted and any duplicate points discarded.

The first and last points are also discarded because of end effects giving incorrect stress values and are replaced using linear extrapolation. Simple cubic splines are then fitted through the stress points to produce the three diagrams (for plotting purposes only).

Thrust and shear

35. If L is the distance from the first Y' point to the last Y' point on the section, then the thrust is computed using numerical integration from

$$T = \int_{Y'_1}^{Y'_1 + L} \sigma'_x \, dY' \qquad (5)$$

Hence Y'_1 is the smallest Y' value.

36. Shear is computed the same way from

$$V = \int_{Y'_1}^{Y'_1 + L} \tau'_{xy} \, dY' \qquad (6)$$

Bending stress and neutral axis

37. The bending stress is simply

$$\sigma_B = \sigma'_x - \frac{T}{L} \qquad (7)$$

The neutral axis is where the bending stress curve intersects the Y' axis and where an equal area of positive stress is separated from the negative stress area. Call this value Y'_N. X'_N is the perpendicular distance from the origin of the grid to the section. The transformation back to the X-Y plane is

$$\begin{bmatrix} X_N \\ Y_N \end{bmatrix} = \begin{bmatrix} \cos A & -\sin A \\ \sin A & \cos A \end{bmatrix} \begin{bmatrix} X'_N \\ Y'_N \end{bmatrix} \qquad (8)$$

Moment

38. The moment is computed (using numerical integration) by integrating the bending stress times moment arm along the length L :

$$M = \int_{Y_1'}^{Y_1' + L} (Y_N' - Y') \sigma_B \, dY' \qquad (9)$$

Verification of the Program

39. The cantilever beam shown in Appendix A can be used to verify the results from CSMT. The moment is linear in this case and can be computed from

$$M = PX$$

where

M = moment

P = load at the end of the beam

X = distance from the load to the point where the moment is to be computed

The total shear is constant at each cross section (only vertical shear is considered) and is equal to the load at the end of the beam. The shear distribution is parabolic. The thrust is zero at all cross sections.

40. If sections are taken 10, 14, and 48 ft* from the end of the beam as shown in Figure 14, the moments are calculated to be 100, 140, and 480 kip-ft. Figures 15-17 show the moments as computed by CSMT to be 96.33, 135.0, and 463.2 kip-ft. These small errors are a result of the finite element discretization of the problem and interpolation of data by the CSMT program.

41. Table 1 shows a summary of shears and moments with percent errors. The calculated shears, moments, and thrusts are for sections taken at 10, 14, and 48 ft.

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* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.

```
COMMAND?
= P S
COMMAND?
=
```

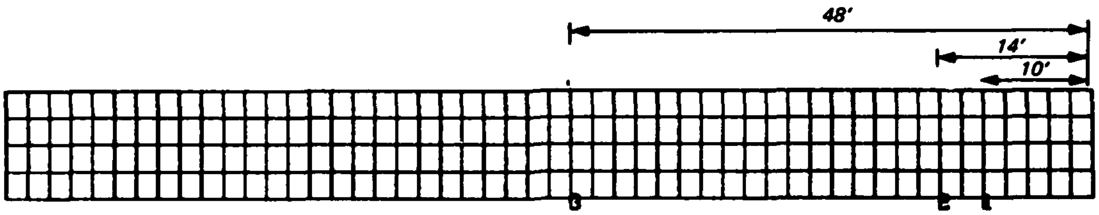

Figure 14. Locations of sections through beam

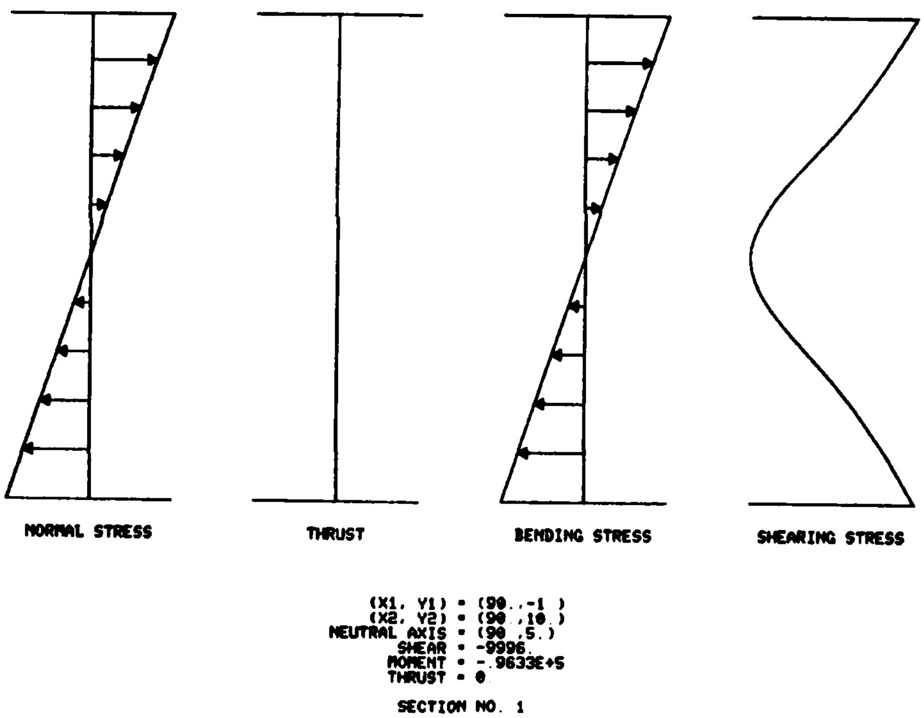

Figure 15. CSMT results for section 10 ft from beam end

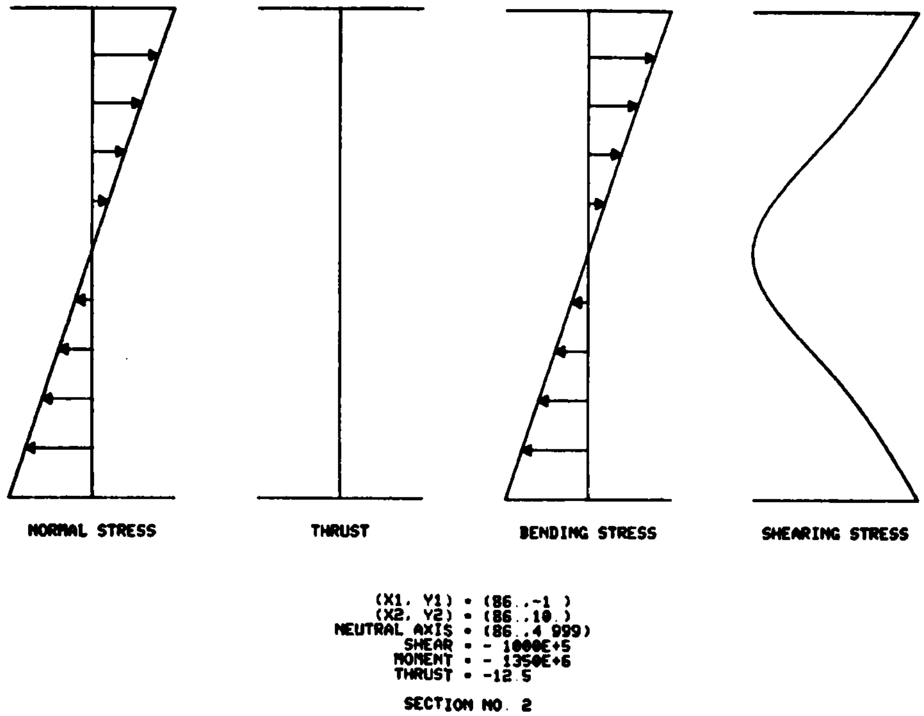

Figure 16. CSMT results for section 14 ft from beam end

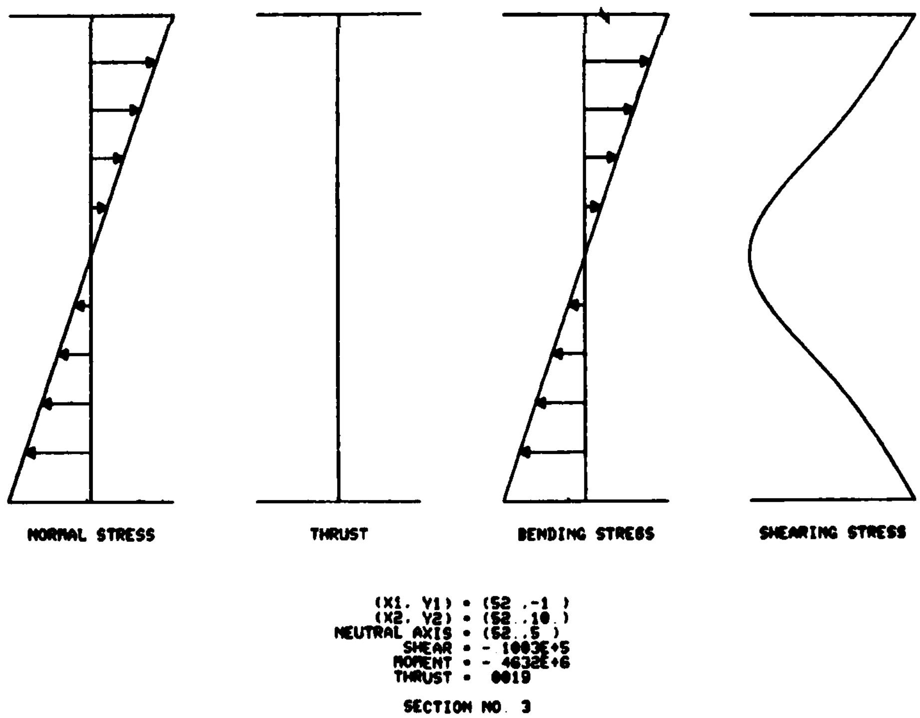

Figure 17. CSMT results for section 48 ft from beam end

Table 1

Summary of Shears and Moments

Distance from Load, ft	Shear: Calculated lb	Shear: Computed by CSMT lb	Shear: Percent Error	Moment: Calculated lb-ft	Moment: Computed by CSMT lb-ft	Moment: Percent Error
10	-10,000	-9996.	0.04	100,000	96330.	3.67
14	-10,000	-10000.	0.00	140,000	135000.	3.57
48	-10,000	-10030.	0.30	480,000	463200.	3.50

Appendix A: Producing Geometry and Stress Data Files

1. The output file from a typical FE analysis run (pages A2-A9) for the cantilever beam shown in Figure A1 contains both the geometry and stress data. This output will be in a different format for each FE program. The user must then use the editor available on the computer where the output file exists to remove the unnecessary data.

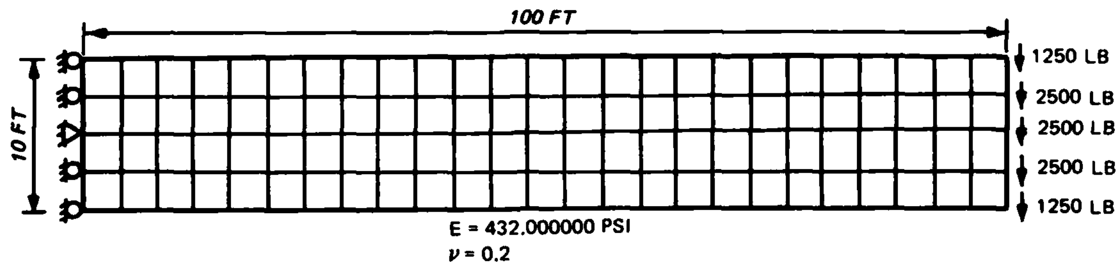

Figure A1. Example cantilever beam

2. Typical editing sessions for the geometry file on the U. S. Army Engineer Waterways Experiment Station (WES) and Boeing Computer Services systems are shown on page A10. Editors on different computers will have different commands but should have the basic capabilities illustrated here. All data except for the node and element data have been removed from the file shown on pages A11-A13. This file (GEOM1) now contains all node and element data but needs to be rewritten in order to be read by CSMT. The simple program for the WES computer shown on page A14 will generate the final geometry data file (FGEOM1) shown on pages A15-A17.

3. Typical editing sessions on the WES and Boeing systems for separating the stress data from the output file are listed on page A18. The stress data file (STRF1) which was created by editing the output file (pages A2-A9) is shown on pages A19-A21. The file STRF1 must now be written for the program CSMT to read. The program for the WES computer shown on page A22 will generate the final stress data file (FSTRF1) shown on pages A23 and A24.

Output File from a Typical FE Run

BEAM PROBLEM - LITTLE GRID

NUMBER OF NODAL POINTS------130
NUMBER OF ELEMENTS----------100
NUMBER OF DIFF. MATERIALS--- 1
NUMBER OF PRESSURE CARDS---- 0
X-ACCELERATION-------------- 0.
Y-ACCELERATION-------------- 0.
REFERENCE TEMPERATURE------- 0.
NUMBER OF APPROXIMATIONS---- 1

MAT. NO. 1 NO. OF TEMP. CARDS = 1 MASS DENSITY = 0.

TEMP.	E(C)	NU	E(T)	G/H2	ALPHA	STRESS
0.	0.432E 09	0.200E 00	0.432E 09	0.	0.	0.

NODE	TYPE	X	Y	X-LOAD/DISP	Y-LOAD/DISP	TEMP.
1	1.0	0.	10.0	0.	0.	0.
2	1.0	0.	7.5	0.	0.	0.
3	0.	4.0	10.0	0.	0.	0.
4	3.0	0.	5.0	0.	0.	0.
5	0.	4.0	7.5	0.	0.	0.
6	0.	8.0	10.0	0.	0.	0.
7	1.0	0.	2.5	0.	0.	0.
8	0.	4.0	5.0	0.	0.	0.
9	0.	8.0	7.5	0.	0.	0.
10	0.	12.0	10.0	0.	0.	0.
11	1.0	0.	0.	0.	0.	0.
12	0.	4.0	2.5	0.	0.	0.
13	0.	8.0	5.0	0.	0.	0.
14	0.	12.0	7.5	0.	0.	0.
15	0.	16.0	10.0	0.	0.	0.
16	0.	4.0	0.	0.	0.	0.
17	0.	8.0	2.5	0.	0.	0.
18	0.	12.0	5.0	0.	0.	0.
19	0.	16.0	7.5	0.	0.	0.
20	0.	20.0	10.0	0.	0.	0.
21	0.	8.0	0.	0.	0.	0.
22	0.	12.0	2.5	0.	0.	0.
23	0.	16.0	5.0	0.	0.	0.
24	0.	20.0	7.5	0.	0.	0.
25	0.	24.0	10.0	0.	0.	0.
26	0.	12.0	0.	0.	0.	0.
27	0.	16.0	2.5	0.	0.	0.
28	0.	20.0	5.0	0.	0.	0.
29	0.	24.0	7.5	0.	0.	0.
30	0.	28.0	10.0	0.	0.	0.
31	0.	16.0	0.	0.	0.	0.
32	0.	20.0	2.5	0.	0.	0.
33	0.	24.0	5.0	0.	0.	0.
34	0.	28.0	7.5	0.	0.	0.
35	0.	32.0	10.0	0.	0.	0.
36	0.	20.0	0.	0.	0.	0.
37	0.	24.0	2.5	0.	0.	0.
38	0.	28.0	5.0	0.	0.	0.
39	0.	32.0	7.5	0.	0.	0.
40	0.	36.0	10.0	0.	0.	0.
41	0.	24.0	0.	0.	0.	0.
42	0.	28.0	2.5	0.	0.	0.
43	0.	32.0	5.0	0.	0.	0.
44	0.	36.0	7.5	0.	0.	0.
45	0.	40.0	10.0	0.	0.	0.
46	0.	28.0	0.	0.	0.	0.
47	0.	32.0	2.5	0.	0.	0.
48	0.	36.0	5.0	0.	0.	0.
49	0.	40.0	7.5	0.	0.	0.
50	0.	44.0	10.0	0.	0.	0.
51	0.	32.0	0.	0.	0.	0.
52	0.	36.0	2.5	0.	0.	0.
53	0.	40.0	5.0	0.	0.	0.
54	0.	44.0	7.5	0.	0.	0.
55	0.	48.0	10.0	0.	0.	0.
56	0.	36.0	0.	0.	0.	0.
57	0.	40.0	2.5	0.	0.	0.
58	0.	44.0	5.0	0.	0.	0.

59	0.	48.0	7.5	0.	0.	0.
60	0.	52.0	10.0	0.	0.	0.
61	0.	40.0	0.	0.	0.	0.
62	0.	44.0	2.5	0.	0.	0.
63	0.	48.0	5.0	0.	0.	0.
64	0.	52.0	7.5	0.	0.	0.
65	0.	56.0	10.0	0.	0.	0.
66	0.	44.0	0.	0.	0.	0.
67	0.	48.0	2.5	0.	0.	0.
68	0.	52.0	5.0	0.	0.	0.
69	0.	56.0	7.5	0.	0.	0.
70	0.	60.0	10.0	0.	0.	0.
71	0.	48.0	0.	0.	0.	0.
72	0.	52.0	2.5	0.	0.	0.
73	0.	56.0	5.0	0.	0.	0.
74	0.	60.0	7.5	0.	0.	0.
75	0.	64.0	10.0	0.	0.	0.
76	0.	52.0	0.	0.	0.	0.
77	0.	56.0	2.5	0.	0.	0.
78	0.	60.0	5.0	0.	0.	0.
79	0.	64.0	7.5	0.	0.	0.
80	0.	68.0	10.0	0.	0.	0.
81	0.	56.0	0.	0.	0.	0.
82	0.	60.0	2.5	0.	0.	0.
83	0.	64.0	5.0	0.	0.	0.
84	0.	68.0	7.5	0.	0.	0.
85	0.	72.0	10.0	0.	0.	0.
86	0.	60.0	0.	0.	0.	0.
87	0.	64.0	2.5	0.	0.	0.
88	0.	68.0	5.0	0.	0.	0.
89	0.	72.0	7.5	0.	0.	0.
90	0.	76.0	10.0	0.	0.	0.
91	0.	64.0	0.	0.	0.	0.
92	0.	68.0	2.5	0.	0.	0.
93	0.	72.0	5.0	0.	0.	0.
94	0.	76.0	7.5	0.	0.	0.
95	0.	80.0	10.0	0.	0.	0.
96	0.	68.0	0.	0.	0.	0.
97	0.	72.0	2.5	0.	0.	0.
98	0.	76.0	5.0	0.	0.	0.
99	0.	80.0	7.5	0.	0.	0.
100	0.	84.0	10.0	0.	0.	0.
101	0.	72.0	0.	0.	0.	0.
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103	0.	80.0	5.0	0.	0.	0.
104	0.	84.0	7.5	0.	0.	0.
105	0.	88.0	10.0	0.	0.	0.
106	0.	76.0	0.	0.	0.	0.
107	0.	80.0	2.5	0.	0.	0.
108	0.	84.0	5.0	0.	0.	0.
109	0.	88.0	7.5	0.	0.	0.
110	0.	92.0	10.0	0.	0.	0.
111	0.	80.0	0.	0.	0.	0.
112	0.	84.0	2.5	0.	0.	0.
113	0.	88.0	5.0	0.	0.	0.
114	0.	92.0	7.5	0.	0.	0.
115	0.	96.0	10.0	0.	0.	0.
116	0.	84.0	0.	0.	0.	0.
117	0.	88.0	2.5	0.	0.	0.
118	0.	92.0	5.0	0.	0.	0.
119	0.	96.0	7.5	0.	0.	0.
120	0.	100.0	10.0	0.	-0.125E 04	0.
121	0.	88.0	0.	0.	0.	0.
122	0.	92.0	2.5	0.	0.	0.
123	0.	96.0	5.0	0.	0.	0.
124	0.	100.0	7.5	0.	-0.250E 04	0.
125	0.	92.0	0.	0.	0.	0.
126	0.	96.0	2.5	0.	0.	0.
127	0.	100.0	5.0	0.	-0.250E 04	0.
128	0.	96.0	0.	0.	0.	0.
129	0.	100.0	2.5	0.	-0.250E 04	0.
130	0.	100.0	0.	0.	-0.125E 04	0.

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3	21	26	22	17	1
4	26	31	27	22	1
5	31	36	32	27	1
6	36	41	37	32	1
7	41	46	42	37	1
8	46	51	47	42	1
9	51	56	52	47	1
10	56	61	57	52	1

11	61	66	62	57	1
12	66	71	67	62	1
13	71	76	72	67	1
14	76	81	77	72	1
15	81	86	82	77	1
16	86	91	87	82	1
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18	96	101	97	92	1
19	101	106	102	97	1
20	106	111	107	102	1
21	111	116	112	107	1
22	116	121	117	112	1
23	121	125	122	117	1
24	125	128	126	122	1
25	128	130	129	126	1
26	7	12	8	4	1
27	12	17	13	8	1
28	17	22	18	13	1
29	22	27	23	18	1
30	27	32	28	23	1
31	32	37	33	28	1
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68	88	93	89	84	1
69	93	98	94	89	1
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74	118	123	119	114	1
75	123	127	124	119	1
76	2	5	3	1	1
77	5	9	6	3	1
78	9	14	10	6	1
79	14	19	15	10	1
80	19	24	20	15	1
81	24	29	25	20	1
82	29	34	30	25	1
83	34	39	35	30	1
84	39	44	40	35	1
85	44	49	45	40	1
86	49	54	50	45	1
87	54	59	55	50	1
88	59	64	60	55	1
89	64	69	65	60	1
90	69	74	70	65	1
91	74	79	75	70	1
92	79	84	80	75	1
93	84	89	85	80	1
94	89	94	90	85	1
95	94	99	95	90	1
96	99	104	100	95	1
97	104	109	105	100	1
98	109	114	110	105	1
99	114	119	115	110	1
100	119	124	120	115	1

NODE	X-DISP.	Y-DISP.
1	0.	-0.7832E-04
2	0.	-0.2855E-04
3	0.4949E-03	-0.2909E-03
4	0.	0.
5	0.2447E-03	-0.2459E-03
6	0.9678E-03	-0.8972E-03
7	0.	-0.2855E-04
8	-0.1187E-09	-0.2331E-03
9	0.4794E-03	-0.8541E-03
10	0.1420E-02	-0.1873E-02
11	0.	-0.7832E-04
12	-0.2447E-03	-0.2459E-03
13	-0.2269E-09	-0.8395E-03
14	0.7055E-03	-0.1831E-02
15	0.1851E-02	-0.3202E-02
16	-0.4949E-03	-0.2909E-03
17	-0.4794E-03	-0.8541E-03
18	-0.3362E-09	-0.1818E-02
19	0.9214E-03	-0.3162E-02
20	0.2263E-02	-0.4868E-02
21	-0.9678E-03	-0.8972E-03
22	-0.7055E-03	-0.1831E-02
23	-0.4632E-09	-0.3149E-02
24	0.1127E-02	-0.4831E-02
25	0.2655E-02	-0.6856E-02
26	-0.1420E-02	-0.1873E-02
27	-0.9214E-03	-0.3162E-02
28	-0.5981E-09	-0.4818E-02
29	0.1323E-02	-0.6820E-02
30	0.3026E-02	-0.9149E-02
31	-0.1851E-02	-0.3202E-02
32	-0.1127E-02	-0.4831E-02
33	-0.6927E-09	-0.6808E-02
34	0.1509E-02	-0.9115E-02
35	0.3378E-02	-0.1173E-01
36	-0.2263E-02	-0.4868E-02
37	-0.1323E-02	-0.6820E-02
38	-0.8245E-09	-0.9104E-02
39	0.1685E-02	-0.1170E-01
40	0.3709E-02	-0.1459E-01
41	-0.2655E-02	-0.6856E-02
42	-0.1509E-02	-0.9115E-02
43	-0.1131E-08	-0.1169E-01
44	0.1850E-02	-0.1456E-01
45	0.4021E-02	-0.1770E-01
46	-0.3026E-02	-0.9149E-02
47	-0.1685E-02	-0.1170E-01
48	-0.1105E-08	-0.1455E-01
49	0.2006E-02	-0.1767E-01
50	0.4312E-02	-0.2105E-01
51	-0.3378E-02	-0.1173E-01
52	-0.1850E-02	-0.1456E-01
53	-0.8416E-09	-0.1766E-01
54	0.2152E-02	-0.2103E-01
55	0.4583E-02	-0.2463E-01
56	-0.3709E-02	-0.1459E-01
57	-0.2006E-02	-0.1767E-01
58	-0.9294E-09	-0.2102E-01
59	0.2287E-02	-0.2461E-01
60	0.4834E-02	-0.2842E-01
61	-0.4021E-02	-0.1770E-01
62	-0.2152E-02	-0.2103E-01
63	-0.1480E-08	-0.2460E-01
64	0.2413E-02	-0.2840E-01
65	0.5065E-02	-0.3240E-01
66	-0.4312E-02	-0.2105E-01
67	-0.2287E-02	-0.2461E-01
68	-0.1471E-08	-0.2839E-01
69	0.2528E-02	-0.3238E-01
70	0.5276E-02	-0.3656E-01
71	-0.4583E-02	-0.2463E-01
72	-0.2413E-02	-0.2840E-01
73	-0.1208E-08	-0.3237E-01
74	0.2634E-02	-0.3654E-01
75	0.5467E-02	-0.4087E-01
76	-0.4834E-02	-0.2842E-01
77	-0.2528E-02	-0.3238E-01

78	-0.1136E-08	-0.3653E-01
79	0.2729E-02	-0.4086E-01
80	0.5638E-02	0.4534E-01
81	-0.5065E-02	-0.3240E-01
82	-0.2634E-02	-0.3654E-01
83	-0.1411E-08	-0.4085E-01
84	0.2815E-02	-0.4532E-01
85	0.5789E-02	-0.4993E-01
86	-0.5276E-02	-0.3656E-01
87	-0.2729E-02	-0.4086E-01
88	-0.1068E-08	-0.4532E-01
89	0.2890E-02	-0.4992E-01
90	0.5919E-02	-0.5463E-01
91	-0.5467E-02	-0.4087E-01
92	-0.2815E-02	-0.4532E-01
93	0.7624E-10	-0.4991E-01
94	0.2955E-02	-0.5462E-01
95	0.6030E-02	-0.5943E-01
96	-0.5638E-02	-0.4534E-01
97	-0.2890E-02	-0.4992E-01
98	0.2374E-09	-0.5462E-01
99	0.3011E-02	-0.5942E-01
100	0.6120E-02	-0.6431E-01
101	-0.5789E-02	-0.4993E-01
102	-0.2955E-02	-0.5462E-01
103	0.1750E-09	-0.5942E-01
104	0.3056E-02	-0.6431E-01
105	0.6191E-02	-0.6926E-01
106	-0.5919E-02	-0.5463E-01
107	-0.3011E-02	-0.5942E-01
108	0.2550E-09	-0.6430E-01
109	0.3091E-02	-0.6925E-01
110	0.6241E-02	-0.7425E-01
111	-0.6030E-02	-0.5943E-01
112	-0.3056E-02	-0.6431E-01
113	-0.2102E-09	-0.6925E-01
114	0.3116E-02	-0.7425E-01
115	0.6271E-02	-0.7928E-01
116	-0.6120E-02	-0.6431E-01
117	-0.3091E-02	-0.6925E-01
118	-0.5393E-09	-0.7425E-01
119	0.3131E-02	-0.7928E-01
120	0.6282E-02	-0.8432E-01
121	-0.6191E-02	-0.6926E-01
122	-0.3116E-02	-0.7425E-01
123	-0.7699E-09	-0.7928E-01
124	0.3136E-02	-0.8432E-01
125	-0.6241E-02	-0.7425E-01
126	-0.3131E-02	-0.7928E-01
127	0.1486E-09	-0.8432E-01
128	-0.6271E-02	-0.7928E-01
129	-0.3136E-02	-0.8432E-01
130	-0.6282E-02	-0.8432E-01

EL.	X	X-STRESS	MAX-STRESS	XY-STRESS
NO.	Y	Y-STRESS	MIN-STRESS	ANGLE
1	2.0	-0.399E 05	0.217E 03	-0.669E 03
	1.3	0.206E 03	-0.399E 05	-0.892E 02
2	6.0	-0.382E 05	-0.189E 02	-0.736E 03
	1.3	-0.331E 02	-0.382E 05	-0.891E 02
3	10.0	-0.366E 05	0.201E 00	-0.653E 03
	1.3	-0.115E 02	-0.366E 05	-0.891E 02
4	14.0	-0.350E 05	0.156E 02	-0.659E 03
	1.3	0.317E 01	-0.350E 05	-0.891E 02
5	18.0	-0.333E 05	0.126E 02	-0.659E 03
	1.3	-0.434E 00	-0.334E 05	-0.890E 02
6	22.0	-0.317E 05	0.137E 02	-0.659E 03
	1.3	0.605E-01	-0.317E 05	-0.890E 02
7	26.0	-0.301E 05	0.144E 02	-0.659E 03
	1.3	0.409E-02	-0.301E 05	-0.889E 02
8	30.0	-0.285E 05	0.152E 02	-0.659E 03
	1.3	-0.396E-02	-0.285E 05	-0.888E 02
9	34.0	-0.268E 05	0.162E 02	-0.659E 03
	1.3	-0.136E-01	-0.269E 05	-0.887E 02
10	38.0	-0.252E 05	0.172E 02	-0.659E 03
	1.3	-0.315E-01	-0.252E 05	-0.887E 02

11	42.0	-0.236E 05	0.184E 02	-0.659E 03
	1.3	0.105E-01	-0.236E 05	-0.886E 02
12	46.0	-0.220E 05	0.199E 02	-0.659E 03
	1.3	0.110E 00	-0.220E 05	-0.884E 02
13	50.0	-0.203E 05	0.214E 02	-0.659E 03
	1.3	0.453E-01	-0.204E 05	-0.883E 02
14	54.0	-0.187E 05	0.231E 02	-0.659E 03
	1.3	-0.789E-01	-0.187E 05	-0.881E 02
15	58.0	-0.171E 05	0.253E 02	-0.659E 03
	1.3	-0.755E-01	-0.171E 05	-0.879E 02
16	62.0	-0.155E 05	0.282E 02	-0.660E 03
	1.3	0.158E 00	-0.155E 05	-0.877E 02
17	66.0	-0.138E 05	0.315E 02	-0.659E 03
	1.3	0.131E 00	-0.139E 05	-0.874E 02
18	70.0	-0.122E 05	0.354E 02	-0.660E 03
	1.3	-0.170E 00	-0.122E 05	-0.871E 02
19	74.0	-0.106E 05	0.410E 02	-0.660E 03
	1.3	0.134E-01	-0.106E 05	-0.866E 02
20	78.0	-0.896E 04	0.483E 02	-0.660E 03
	1.3	-0.459E-01	-0.900E 04	-0.860E 02
21	82.0	-0.733E 04	0.588E 02	-0.660E 03
	1.3	-0.192E 00	-0.739E 04	-0.850E 02
22	86.0	-0.570E 04	0.755E 02	-0.660E 03
	1.3	0.988E-01	-0.578E 04	-0.836E 02
23	90.0	-0.407E 04	0.105E 03	-0.661E 03
	1.3	0.383E 00	-0.418E 04	-0.811E 02
24	94.0	-0.244E 04	0.135E 03	-0.643E 03
	1.3	-0.249E 02	-0.260E 04	-0.761E 02
25	98.0	-0.814E 03	0.517E 03	-0.677E 03
	1.3	0.172E 03	-0.116E 04	-0.631E 02

EL.	X	X-STRESS	MAX-STRESS	XY-STRESS
NO.	Y	Y-STRESS	MIN-STRESS	ANGLE
26	2.0	-0.130E 05	0.110E 04	-0.133E 04
	3.8	0.976E 03	-0.131E 05	-0.848E 02
27	6.0	-0.127E 05	-0.448E 02	-0.126E 04
	3.8	-0.170E 03	-0.128E 05	-0.845E 02
28	10.0	-0.122E 05	0.156E 03	-0.134E 04
	3.8	0.103E 02	-0.123E 05	-0.839E 02
29	14.0	-0.117E 05	0.151E 03	-0.134E 04
	3.8	-0.417E 00	-0.118E 05	-0.837E 02
30	18.0	-0.111E 05	0.159E 03	-0.134E 04
	3.8	0.216E 00	-0.113E 05	-0.834E 02
31	22.0	-0.106E 05	0.166E 03	-0.134E 04
	3.8	-0.443E-01	-0.107E 05	-0.831E 02
32	26.0	-0.100E 05	0.175E 03	-0.134E 04
	3.8	0.321E-01	-0.102E 05	-0.827E 02
33	30.0	-0.949E 04	0.185E 03	-0.134E 04
	3.8	0.130E-01	-0.968E 04	-0.823E 02
34	34.0	-0.895E 04	0.195E 03	-0.134E 04
	3.8	-0.212E-01	-0.914E 04	-0.818E 02
35	38.0	-0.841E 04	0.207E 03	-0.134E 04
	3.8	-0.458E-01	-0.861E 04	-0.813E 02
36	42.0	-0.786E 04	0.221E 03	-0.134E 04
	3.8	-0.186E-01	-0.809E 04	-0.808E 02
37	46.0	-0.732E 04	0.236E 03	-0.134E 04
	3.8	-0.121E-03	-0.756E 04	-0.801E 02
38	50.0	-0.678E 04	0.254E 03	-0.134E 04
	3.8	-0.133E 00	-0.703E 04	-0.794E 02
39	54.0	-0.624E 04	0.274E 03	-0.134E 04
	3.8	-0.181E 00	-0.651E 04	-0.785E 02
40	58.0	-0.570E 04	0.298E 03	-0.134E 04
	3.8	-0.107E 00	-0.599E 04	-0.776E 02
41	62.0	-0.515E 04	0.326E 03	-0.134E 04
	3.8	-0.763E-01	-0.548E 04	-0.764E 02
42	66.0	-0.461E 04	0.360E 03	-0.134E 04
	3.8	-0.136E 00	-0.497E 04	-0.751E 02
43	70.0	-0.407E 04	0.400E 03	-0.134E 04
	3.8	-0.364E 00	-0.447E 04	-0.735E 02
44	74.0	-0.353E 04	0.450E 03	-0.134E 04
	3.8	-0.803E-01	-0.398E 04	-0.715E 02
45	78.0	-0.299E 04	0.512E 03	-0.134E 04
	3.8	0.464E-01	-0.350E 04	-0.692E 02
46	82.0	-0.244E 04	0.590E 03	-0.134E 04
	3.8	-0.722E-01	-0.303E 04	-0.663E 02
47	86.0	-0.190E 04	0.691E 03	-0.134E 04
	3.8	0.431E 00	-0.259E 04	-0.628E 02
48	90.0	-0.136E 04	0.820E 03	-0.134E 04
	3.8	-0.104E 01	-0.218E 04	-0.586E 02
49	94.0	-0.803E 03	0.100E 04	-0.136E 04
	3.8	-0.195E 02	-0.182E 04	-0.531E 02
50	98.0	-0.245E 03	0.128E 04	-0.132E 04
	3.8	0.140E 03	-0.139E 04	-0.492E 02

EL.	X	X-STRESS	MAX-STRESS	XY-STRESS
NO.	Y	Y-STRESS	MIN-STRESS	ANGLE
51	2.0	0.130E 05	0.131E 05	-0.133E 04
	6.3	-0.976E 03	-0.110E 04	-0.538E 01
52	6.0	0.127E 05	0.128E 05	-0.126E 04
	6.3	0.170E 03	0.448E 02	-0.569E 01
53	10.0	0.122E 05	0.123E 05	-0.134E 04
	6.3	-0.103E 02	-0.156E 03	-0.621E 01
54	14.0	0.117E 05	0.118E 05	-0.134E 04
	6.3	0.421E C0	-0.151E 03	-0.647E 01
55	18.0	0.111E 05	0.113E 05	-0.134E 04
	6.3	-0.217E 00	-0.159E 03	-0.677E 01
56	22.0	0.106E 05	0.107E 05	-0.134E 04
	6.3	0.635E-01	-0.166E 03	-0.711E 01
57	26.0	0.100E 05	0.102E 05	-0.134E 04
	6.3	0.173E-01	-0.175E 03	-0.747E 01
58	30.0	0.949E 04	0.968E 04	-0.134E 04
	6.3	0.502E-01	-0.185E 03	-0.788E 01
59	34.0	0.895E 04	0.914E 04	-0.134E 04
	6.3	-0.421E-01	-0.195E 03	-0.833E 01
60	38.0	0.841E 04	0.861E 04	-0.134E 04
	6.3	-0.991E-01	-0.208E 03	-0.884E 01
61	42.0	0.786E 04	0.809E 04	-0.134E 04
	6.3	0.200E-01	-0.221E 03	-0.940E 01
62	46.0	0.732E 04	0.756E 04	-0.134E 04
	6.3	0.994E-01	-0.236E 03	-0.100E 02
63	50.0	0.678E 04	0.703E 04	-0.134E 04
	6.3	-0.585E-01	-0.254E 03	-0.108E 02
64	54.0	0.624E 04	0.651E 04	-0.134E 04
	6.3	-0.110E 00	-0.275E 03	-0.116E 02
65	58.0	0.570E 04	0.599E 04	-0.134E 04
	6.3	-0.289E-02	-0.298E 03	-0.126E 02
66	62.0	0.515E 04	0.548E 04	-0.134E 04
	6.3	0.406E-02	-0.326E 03	-0.137E 02
67	66.0	0.461E 04	0.497E 04	-0.134E 04
	6.3	-0.202E 00	-0.360E 03	-0.151E 02
68	70.0	0.407E 04	0.447E 04	-0.134E 04
	6.3	-0.240E 00	-0.400E 03	-0.167E 02
69	74.0	0.353E 04	0.398E 04	-0.134E 04
	6.3	-0.582E-01	-0.450E 03	-0.186E 02
70	78.0	0.299E 04	0.350E 04	-0.134E 04
	6.3	-0.593E-01	-0.512E 03	-0.210E 02
71	82.0	0.244E 04	0.303E 04	-0.134E 04
	6.3	0.428E-01	-0.590E 03	-0.238E 02
72	86.0	0.190E 04	0.259E 04	-0.134E 04
	6.3	-0.411E 00	-0.691E 03	-0.274E 02
73	90.0	0.136E 04	0.218E 04	-0.134E 04
	6.3	0.980E 00	-0.820E 03	-0.316E 02
74	94.0	0.803E 03	0.182E 04	-0.136E 04
	6.3	0.194E 02	-0.100E 04	-0.370E 02
75	98.0	0.245E 03	0.139E 04	-0.132E 04
	6.3	-0.140E 03	-0.128E 04	-0.409E 02

EL.	X	X-STRESS	MAX-STRESS	XY-STRESS
NO.	Y	Y-STRESS	MIN-STRESS	ANGLE
76	2.0	0.399E 05	0.399E 05	-0.649E 03
	8.8	-0.206E 03	-0.217E 03	-0.957E 00
77	6.0	0.382E 05	0.382E 05	-0.736E 03
	8.8	0.331E 02	0.189E 02	-0.111E 01
78	10.0	0.366E 05	0.366E 05	-0.653E 03
	8.8	0.115E 02	-0.199E 00	-0.102E 01
79	14.0	0.350E 05	0.350E 05	-0.659E 03
	8.8	-0.317E 01	-0.156E 02	-0.108E 01
80	18.0	0.333E 05	0.334E 05	-0.659E 03
	8.8	0.434E 00	-0.126E 02	-0.113E 01
81	22.0	0.317E 05	0.317E 05	-0.659E 03
	8.8	-0.472E-01	-0.137E 02	-0.119E 01
82	26.0	0.301E 05	0.301E 05	-0.659E 03
	8.8	0.223E-01	-0.144E 02	-0.126E 01
83	30.0	0.285E 05	0.285E 05	-0.659E 03
	8.8	0.129E-01	-0.152E 02	-0.133E 01
84	34.0	0.268E 05	0.269E 05	-0.659E 03
	8.8	0.560E-01	-0.161E 02	-0.141E 01
85	38.0	0.252E 05	0.252E 05	-0.659E 03
	8.8	-0.170E-01	-0.172E 02	-0.150E 01
86	42.0	0.236E 05	0.236E 05	-0.659E 03
	8.8	-0.346E-01	-0.184E 02	-0.160E 01
87	46.0	0.220E 05	0.220E 05	-0.659E 03
	8.8	0.149E-01	-0.197E 02	-0.172E 01

88	50.0	0.203E 05	0.204E 05	-0.659E 03
	8.8	-0.193E-01	-0.214E 02	-0.186E 01
89	54.0	0.187E 05	0.187E 05	-0.659E 03
	8.8	-0.121E 00	-0.233E 02	-0.202E 01
90	58.0	0.171E 05	0.171E 05	-0.659E 03
	8.8	-0.199E-01	-0.254E 02	-0.221E 01
91	62.0	0.155E 05	0.155E 05	-0.659E 03
	8.8	0.863E-01	-0.280E 02	-0.244E 01
92	66.0	0.138E 05	0.139E 05	-0.660E 03
	8.8	-0.463E-02	-0.314E 02	-0.273E 01
93	70.0	0.122E 05	0.122E 05	-0.660E 03
	8.8	-0.450E-01	-0.356E 02	-0.309E 01
94	74.0	0.106E 05	0.106E 05	-0.659E 03
	8.8	-0.239E-01	-0.410E 02	-0.356E 01
95	78.0	0.896E 04	0.900E 04	-0.660E 03
	8.8	-0.360E-01	-0.484E 02	-0.420E 01
96	82.0	0.733E 04	0.739E 04	-0.660E 03
	8.8	-0.305E-01	-0.590E 02	-0.511E 01
97	86.0	0.570E 04	0.578E 04	-0.660E 03
	8.8	-0.105E 00	-0.756E 02	-0.653E 01
98	90.0	0.407E 04	0.418E 04	-0.661E 03
	8.8	-0.953E-01	-0.105E 03	-0.901E 01
99	94.0	0.244E 04	0.260E 04	-0.643E 03
	8.8	0.250E 02	-0.135E 03	-0.140E 02
100	98.0	0.814E 03	0.116E 04	-0.677E 03
	8.8	-0.172E 03	-0.516E 03	-0.270E 02

Typical Editing Sessions for the Geometry File

```
WES System                                                               Boeing System
*EDIT                                                                    C>CMEDIT
-D;26             (Delete first 26 lines)                                E>DE26
-P                (Print)                                                E>P

  NODE   TYPE          X         Y   X-LOAD/DISP   Y-LOAD/DISP             TEMP.

-D;1              (Delete 1 line)                                        E>DE1
-F;130            (Forward 130 lines) (130 lines of Node data)           E>N130
-P                (Print)                                                E>P


-D;4              (Delete 4 lines)                                       E>DE4
-P                (Print)                                                E>P

  EL. NO.     I     J     K     L     MAT.

-D;1              (Delete 1 line)                                        E>DE1
-F;100            (Forward 100 lines) (100 lines of element data)        E>N100
-D;9000000        (Delete remainder of file)                             E>DE9000000
end of file - request executed 357 times

-SAVE GEOM1       (Edited file)                                          E>File, Ø
DATA SAVED-GEOM1
end of file                                                              File GEOM1 edited
                                                                         and replaced
-DONE
*
```

Listing of Geometry Data File GEOM1

1	1.0	0.	10.0	0.	0.	0.
2	1.0	0.	7.5	0.	0.	0.
3	0.	4.0	10.0	0.	0.	0.
4	3.0	0.	5.0	0.	0.	0.
5	0.	4.0	7.5	0.	0.	0.
6	0.	8.0	10.0	0.	0.	0.
7	1.0	0.	2.5	0.	0.	0.
8	0.	4.0	5.0	0.	0.	0.
9	0.	8.0	7.5	0.	0.	0.
10	0.	12.0	10.0	0.	0.	0.
11	1.0	0.	0.	0.	0.	0.
12	0.	4.0	2.5	0.	0.	0.
13	0.	8.0	5.0	0.	0.	0.
14	0.	12.0	7.5	0.	0.	0.
15	0.	16.0	10.0	0.	0.	0.
16	0.	4.0	0.	0.	0.	0.
17	0.	8.0	2.5	0.	0.	0.
18	0.	12.0	5.0	0.	0.	0.
19	0.	16.0	7.5	0.	0.	0.
20	0.	20.0	10.0	0.	0.	0.
21	0.	8.0	0.	0.	0.	0.
22	0.	12.0	2.5	0.	0.	0.
23	0.	16.0	5.0	0.	0.	0.
24	0.	20.0	7.5	0.	0.	0.
25	0.	24.0	10.0	0.	0.	0.
26	0.	12.0	0.	0.	0.	0.
27	0.	16.0	2.5	0.	0.	0.
28	0.	20.0	5.0	0.	0.	0.
29	0.	24.0	7.5	0.	0.	0.
30	0.	28.0	10.0	0.	0.	0.
31	0.	16.0	0.	0.	0.	0.
32	0.	20.0	2.5	0.	0.	0.
33	0.	24.0	5.0	0.	0.	0.
34	0.	28.0	7.5	0.	0.	0.
35	0.	32.0	10.0	0.	0.	0.
36	0.	20.0	0.	0.	0.	0.
37	0.	24.0	2.5	0.	0.	0.
38	0.	28.0	5.0	0.	0.	0.
39	0.	32.0	7.5	0.	0.	0.
40	0.	36.0	10.0	0.	0.	0.
41	0.	24.0	0.	0.	0.	0.
42	0.	28.0	2.5	0.	0.	0.
43	0.	32.0	5.0	0.	0.	0.
44	0.	36.0	7.5	0.	0.	0.
45	0.	40.0	10.0	0.	0.	0.
46	0.	28.0	0.	0.	0.	0.
47	0.	32.0	2.5	0.	0.	0.
48	0.	36.0	5.0	0.	0.	0.
49	0.	40.0	7.5	0.	0.	0.
50	0.	44.0	10.0	0.	0.	0.
51	0.	32.0	0.	0.	0.	0.
52	0.	36.0	2.5	0.	0.	0.
53	0.	40.0	5.0	0.	0.	0.
54	0.	44.0	7.5	0.	0.	0.
55	0.	48.0	10.0	0.	0.	0.
56	0.	36.0	0.	0.	0.	0.
57	0.	40.0	2.5	0.	0.	0.
58	0.	44.0	5.0	0.	0.	0.
59	0.	48.0	7.5	0.	0.	0.
60	0.	52.0	10.0	0.	0.	0.
61	0.	40.0	0.	0.	0.	0.
62	0.	44.0	2.5	0.	0.	0.
63	0.	48.0	5.0	0.	0.	0.
64	0.	52.0	7.5	0.	0.	0.
65	0.	56.0	10.0	0.	0.	0.
66	0.	44.0	0.	0.	0.	0.
67	0.	48.0	2.5	0.	0.	0.
68	0.	52.0	5.0	0.	0.	0.
69	0.	56.0	7.5	0.	0.	0.
70	0.	60.0	10.0	0.	0.	0.
71	0.	48.0	0.	0.	0.	0.
72	0.	52.0	2.5	0.	0.	0.
73	0.	56.0	5.0	0.	0.	0.
74	0.	60.0	7.5	0.	0.	0.
75	0.	64.0	10.0	0.	0.	0.
76	0.	52.0	0.	0.	0.	0.
77	0.	56.0	2.5	0.	0.	0.
78	0.	60.0	5.0	0.	0.	0.
79	0.	64.0	7.5	0.	0.	0.

80	0.	68.0	10.0	0.	0.	0.
81	0.	56.0	0.	0.	0.	0.
82	0.	60.0	2.5	0.	0.	0.
83	0.	64.0	5.0	0.	0.	0.
84	0.	68.0	7.5	0.	0.	0.
85	0.	72.0	10.0	0.	0.	0.
86	0.	60.0	0.	0.	0.	0.
87	0.	64.0	2.5	0.	0.	0.
88	0.	68.0	5.0	0.	0.	0.
89	0.	72.0	7.5	0.	0.	0.
90	0.	76.0	10.0	0.	0.	0.
91	0.	64.0	0.	0.	0.	0.
92	0.	68.0	2.5	0.	0.	0.
93	0.	72.0	5.0	0.	0.	0.
94	0.	76.0	7.5	0.	0.	0.
95	0.	80.0	10.0	0.	0.	0.
96	0.	68.0	0.	0.	0.	0.
97	0.	72.0	2.5	0.	0.	0.
98	0.	76.0	5.0	0.	0.	0.
99	0.	80.0	7.5	0.	0.	0.
100	0.	84.0	10.0	0.	0.	0.
101	0.	72.0	0.	0.	0.	0.
102	0.	76.0	2.5	0.	0.	0.
103	0.	80.0	5.0	0.	0.	0.
104	0.	84.0	7.5	0.	0.	0.
105	0.	88.0	10.0	0.	0.	0.
106	0.	76.0	0.	0.	0.	0.
107	0.	80.0	2.5	0.	0.	0.
108	0.	84.0	5.0	0.	0.	0.
109	0.	88.0	7.5	0.	0.	0.
110	0.	92.0	10.0	0.	0.	0.
111	0.	80.0	0.	0.	0.	0.
112	0.	84.0	2.5	0.	0.	0.
113	0.	88.0	5.0	0.	0.	0.
114	0.	92.0	7.5	0.	0.	0.
115	0.	96.0	10.0	0.	0.	0.
116	0.	84.0	0.	0.	0.	0.
117	0.	88.0	2.5	0.	0.	0.
118	0.	92.0	5.0	0.	0.	0.
119	0.	96.0	7.5	0.	0.	0.
120	0.	100.0	10.0	0.	-0.125E 04	0.
121	0.	88.0	0.	0.	0.	0.
122	0.	92.0	2.5	0.	0.	0.
123	0.	96.0	5.0	0.	0.	0.
124	0.	100.0	7.5	0.	-0.250E 04	0.
125	0.	92.0	0.	0.	0.	0.
126	0.	96.0	2.5	0.	0.	0.
127	0.	100.0	5.0	0.	-0.250E 04	0.
128	0.	96.0	0.	0.	0.	0.
129	0.	100.0	2.5	0.	-0.250E 04	0.
130	0.	100.0	0.	0.	-0.125E 04	0.

1	11	16	12	7	1
2	16	21	17	12	1
3	21	26	22	17	1
4	26	31	27	22	1
5	31	36	32	27	1
6	36	41	37	32	1
7	41	46	42	37	1
8	46	51	47	42	1
9	51	56	52	47	1
10	56	61	57	52	1
11	61	66	62	57	1
12	66	71	67	62	1
13	71	76	72	67	1
14	76	81	77	72	1
15	81	86	82	77	1
16	86	91	87	82	1
17	91	96	92	87	1
18	96	101	97	92	1
19	101	106	102	97	1
20	106	111	107	102	1
21	111	116	112	107	1
22	116	121	117	112	1
23	121	125	122	117	1
24	125	128	126	122	1
25	128	130	129	126	1
26	7	12	8	4	1
27	12	17	13	8	1
28	17	22	18	13	1

29	22	27	23	18	1
30	27	32	28	23	1
31	32	37	33	28	1
32	37	42	38	33	1
33	42	47	43	38	1
34	47	52	48	43	1
35	52	57	53	48	1
36	57	62	58	53	1
37	62	67	63	58	1
38	67	72	68	63	1
39	72	77	73	68	1
40	77	82	78	73	1
41	82	87	83	78	1
42	87	92	88	83	1
43	92	97	93	88	1
44	97	102	98	93	1
45	102	107	103	98	1
46	107	112	108	103	1
47	112	117	113	108	1
48	117	122	118	113	1
49	122	126	123	118	1
50	126	129	127	123	1
51	4	8	5	2	1
52	8	13	9	5	1
53	13	18	14	9	1
54	18	23	19	14	1
55	23	28	24	19	1
56	28	33	29	24	1
57	33	38	34	29	1
58	38	43	39	34	1
59	43	48	44	39	1
60	48	53	49	44	1
61	53	58	54	49	1
62	58	63	59	54	1
63	63	68	64	59	1
64	68	73	69	64	1
65	73	78	74	69	1
66	78	83	79	74	1
67	83	88	84	79	1
68	88	93	89	84	1
69	93	98	94	89	1
70	98	103	99	94	1
71	103	108	104	99	1
72	108	113	109	104	1
73	113	118	114	109	1
74	118	123	119	114	1
75	123	127	124	119	1
76	2	5	3	1	1
77	5	9	6	3	1
78	9	14	10	6	1
79	14	19	15	10	1
80	19	24	20	15	1
81	24	29	25	20	1
82	29	34	30	25	1
83	34	39	35	30	1
84	39	44	40	35	1
85	44	49	45	40	1
86	49	54	50	45	1
87	54	59	55	50	1
88	59	64	60	55	1
89	64	69	65	60	1
90	69	74	70	65	1
91	74	79	75	70	1
92	79	84	80	75	1
93	84	89	85	80	1
94	89	94	90	85	1
95	94	99	95	90	1
96	99	104	100	95	1
97	104	109	105	100	1
98	109	114	110	105	1
99	114	119	115	110	1
100	119	124	120	115	1

Listing of Program on WES Computer for Generating
the Geometry Data File

```
C
C       PROGRAM FOR CREATING GEOMETRY DATA FILE.
C
      DIMENSION IE(6)
      CHARACTER NAME*6, FNAME*8
      LIN = 10000
C
C       ATTACH DATA FILE CONTAINING GEOMETRY DATA.
C
      PRINT, 'ENTER INPUT FILENAME'
      READ 100, NAME
  100 FORMAT (A6)
      ENCODE (FNAME,110) '/', NAME, ';'
  110 FORMAT (A1, A6, A1)
      CALL ATTACH(01, FNAME, 3, 0, IST)
C
C       ATTACH FILE FOR GEOMETRY TO BE WRITTEN
C       INTO IN PROPER FORMAT.
C
      PRINT, 'ENTER OUTPUT FILENAME'
      READ 100, NAME
      ENCODE (FNAME,110) '/', NAME, ';'
      CALL ATTACH(02, FNAME, 3, 0, IST)
C
      PRINT, 'ENTER NUMBER OF NODE POINTS'
      READ 120, NNP
  120 FORMAT (V)
C
      PRINT, 'ENTER NUMBER OF ELEMENTS'
      READ 120, NEL
C
      PRINT, 'ENTER NUMBER OF NODES PER ELEMENT'
      READ 120, NNELE
C
      PRINT, 'ENTER NUMBER OF MATERIAL TYPES'
      READ 120, NMAT
C
      WRITE (2,130) LIN, NNP, NEL, NNELE, NMAT
  130 FORMAT (7I5)
      LIN = LIN + 10
C
C       NODE DATA
C
      DO 150 I = 1, NNP
      READ (1,120) NP, BC, X, Y
      WRITE (2,140) LIN, NP, X, Y
  140 FORMAT (2I5, 2F10.1)
  150 LIN = LIN + 10
C
C       ELEMENT DATA
C
      DO 160 I = 1, NEL
      READ (1,120) NE, IE
      WRITE (2,130) LIN, NE, IE
  160 LIN = LIN + 10
C

      STOP
      END


*
```

Listing of Final Geometry Data File FGEOM1

```
OLD FGEOM1
*LIST

10000  130  100    4     1
10010    1         0.        10.0
10020    2         0.         7.5
10030    3         4.0       10.0
10040    4         0.         5.0
10050    5         4.0        7.5
10060    6         8.0       10.0
10070    7         0.         2.5
10080    8         4.0        5.0
10090    9         8.0        7.5
10100   10        12.0       10.0
10110   11         0.         0.
10120   12         4.0        2.5
10130   13         8.0        5.0
10140   14        12.0        7.5
10150   15        16.0       10.0
10160   16         4.0        0.
10170   17         8.0        2.5
10180   18        12.0        5.0
10190   19        16.0        7.5
10200   20        20.0       10.0
10210   21         8.0        0.
10220   22        12.0        2.5
10230   23        16.0        5.0
10240   24        20.0        7.5
10250   25        24.0       10.0
10260   26        12.0        0.
10270   27        16.0        2.5
10280   28        20.0        5.0
10290   29        24.0        7.5
10300   30        28.0       10.0
10310   31        16.0        0.
10320   32        20.0        2.5
10330   33        24.0        5.0
10340   34        28.0        7.5
10350   35        32.0       10.0
10360   36        20.0        0.
10370   37        24.0        2.5
10380   38        28.0        5.0
10390   39        32.0        7.5
10400   40        36.0       10.0
10410   41        24.0        0.
10420   42        28.0        2.5
10430   43        32.0        5.0
10440   44        36.0        7.5
10450   45        40.0       10.0
10460   46        28.0        0.
10470   47        32.0        2.5
10480   48        36.0        5.0
10490   49        40.0        7.5
10500   50        44.0       10.0
10510   51        32.0        0.
10520   52        36.0        2.5
10530   53        40.0        5.0
10540   54        44.0        7.5
10550   55        48.0       10.0
10560   56        36.0        0.
10570   57        40.0        2.5
10580   58        44.0        5.0
10590   59        48.0        7.5
10600   60        52.0       10.0
10610   61        40.0        0.
10620   62        44.0        2.5
10630   63        48.0        5.0
10640   64        52.0        7.5
10650   65        56.0       10.0
10660   66        44.0        0.
10670   67        48.0        2.5
10680   68        52.0        5.0
10690   69        56.0        7.5
10700   70        60.0       10.0
10710   71        48.0        0.
10720   72        52.0        2.5
10730   73        56.0        5.0
10740   74        60.0        7.5
10750   75        64.0       10.0
10760   76        52.0        0.
10770   77        56.0        2.5
10780   78        60.0        5.0
```

10790	79	64.0	7.5
10800	80	68.0	10.0
10810	81	56.0	0.
10820	82	60.0	2.5
10830	83	64.0	5.0
10840	84	68.0	7.5
10850	85	72.0	10.0
10860	86	60.0	0.
10870	87	64.0	2.5
10880	88	68.0	5.0
10890	89	72.0	7.5
10900	90	76.0	10.0
10910	91	64.0	0.
10920	92	68.0	2.5
10930	93	72.0	5.0
10940	94	76.0	7.5
10950	95	80.0	10.0
10960	96	68.0	0.
10970	97	72.0	2.5
10980	98	76.0	5.0
10990	99	80.0	7.5
11000	100	84.0	10.0
11010	101	72.0	0.
11020	102	76.0	2.5
11030	103	80.0	5.0
11040	104	84.0	7.5
11050	105	88.0	10.0
11060	106	76.0	0.
11070	107	80.0	2.5
11080	108	84.0	5.0
11090	109	88.0	7.5
11100	110	92.0	10.0
11110	111	80.0	0.
11120	112	84.0	2.5
11130	113	88.0	5.0
11140	114	92.0	7.5
11150	115	96.0	10.0
11160	116	84.0	0.
11170	117	88.0	2.5
11180	118	92.0	5.0
11190	119	96.0	7.5
11200	120	100.0	10.0
11210	121	88.0	0.
11220	122	92.0	2.5
11230	123	96.0	5.0
11240	124	100.0	7.5
11250	125	92.0	0.
11260	126	96.0	2.5
11270	127	100.0	5.0
11280	128	96.0	0.
11290	129	100.0	2.5
11300	130	100.0	0.

11310	1	11	16	12	7	1
11320	2	16	21	17	12	1
11330	3	21	26	22	17	1
11340	4	26	31	27	22	1
11350	5	31	36	32	27	1
11360	6	36	41	37	32	1
11370	7	41	46	42	37	1
11380	8	46	51	47	42	1
11390	9	51	56	52	47	1
11400	10	56	61	57	52	1
11410	11	61	66	62	57	1
11420	12	66	71	67	62	1
11430	13	71	76	72	67	1
11440	14	76	81	77	72	1
11450	15	81	86	82	77	1
11460	16	86	91	87	82	1
11470	17	91	96	92	87	1
11480	18	96	101	97	92	1
11490	19	101	106	102	97	1
11500	20	106	111	107	102	1
11510	21	111	116	112	107	1
11520	22	116	121	117	112	1
11530	23	121	125	122	117	1
11540	24	125	128	126	122	1
11550	25	128	130	129	126	1
11560	26	7	12	8	4	1
11570	27	12	17	13	8	1
11580	28	17	22	18	13	1
11590	29	22	27	23	18	1

11600	30	27	32	28	23	1
11610	31	32	37	33	28	1
11620	32	37	42	38	33	1
11630	33	42	47	43	38	1
11640	34	47	52	48	43	1
11650	35	52	57	53	48	1
11660	36	57	62	58	53	1
11670	37	62	67	63	58	1
11680	38	67	72	68	63	1
11690	39	72	77	73	68	1
11700	40	77	82	78	73	1
11710	41	82	87	83	78	1
11720	42	87	92	88	83	1
11730	43	92	97	93	88	1
11740	44	97	102	98	93	1
11750	45	102	107	103	98	1
11760	46	107	112	108	103	1
11770	47	112	117	113	108	1
11780	48	117	122	118	113	1
11790	49	122	126	123	118	1
11800	50	126	129	127	123	1
11810	51	4	8	5	2	1
11820	52	8	13	9	5	1
11830	53	13	18	14	9	1
11840	54	18	23	19	14	1
11850	55	23	28	24	19	1
11860	56	28	33	29	24	1
11870	57	33	38	34	29	1
11880	58	38	43	39	34	1
11890	59	43	48	44	39	1
11900	60	48	53	49	44	1
11910	61	53	58	54	49	1
11920	62	58	63	59	54	1
11930	63	63	68	64	59	1
11940	64	68	73	69	64	1
11950	65	73	78	74	69	1
11960	66	78	83	79	74	1
11970	67	83	88	84	79	1
11980	68	88	93	89	84	1
11990	69	93	98	94	89	1
12000	70	98	103	99	94	1
12010	71	103	108	104	99	1
12020	72	108	113	109	104	1
12030	73	113	118	114	109	1
12040	74	118	123	119	114	1
12050	75	123	127	124	119	1
12060	76	2	5	3	1	1
12070	77	5	9	6	3	1
12080	78	9	14	10	6	1
12090	79	14	19	15	10	1
12100	80	19	24	20	15	1
12110	81	24	29	25	20	1
12120	82	29	34	30	25	1
12130	83	34	39	35	30	1
12140	84	39	44	40	35	1
12150	85	44	49	45	40	1
12160	86	49	54	50	45	1
12170	87	54	59	55	50	1
12180	88	59	64	60	55	1
12190	89	64	69	65	60	1
12200	90	69	74	70	65	1
12210	91	74	79	75	70	1
12220	92	79	84	80	75	1
12230	93	84	89	85	80	1
12240	94	89	94	90	85	1
12250	95	94	99	95	90	1
12260	96	99	104	100	95	1
12270	97	104	109	105	100	1
12280	98	109	114	110	105	1
12290	99	114	119	115	110	1
12300	100	119	124	120	115	1

Typical Editing Sessions for Separating the Stress Data from the Output File

```
WES System                                      Boeing System
*EDIT                                           C>CMEDIT
-D;26                                           E>DE26
-P                                              E>P

  NODE   TYPE       X        Y   X-LOAD/DISP   Y-LOAD/DISP       TEMP.

-D;135                                          E>DE135
-P                                              E>P

  EL. NO.    I     J     K     L   MAT.

-D;107                                          E>DE107
-P                                              E>P

  NODE      X-DISP.      Y-DISP.

-D;135                                          E>DE135
-P                                              E>P

  EL.        X      X-STRESS       MAX-STRESS      XY-STRESS

-D;2                                            E>DE2
-P                                              E>P

    1      2.0    -0.400E 05       0.218E 03     -0.670E 03

-F;50                                           E>N50
-D;3                                            E>DE3
-P                                              E>P

  NO.        Y      Y-STRESS       MIN-STRESS          ANGLE

-D;1                                            E>DE1
-F;50                                           E>N50
-D;4                                            E>DE4
-P                                              E>P

   51      2.0     0.130E 05       0.132E 05     -0.133E 04

-F;50                                           E>N50
-D;4                                            E>DE4
-P                                              E>P

   76      2.0     0.400E 05       0.400E 05     -0.670E 03

-F;50                                           E>N50
-D;4                                            E>D4
end of file - request executed   2 times

-SAVE STRF1                                     E>File 1Ø
DATA SAVED-STRF1                                File STRF2 edited
end of file                                     and replaced

-DONE
*
```

Listing of Stress Data File STRF1

*LIST STRF1

1	2.0	-0.399E 05	0.217E 03	-0.669E 03
	1.3	0.206E 03	-0.399E 05	-0.892E 02
2	6.0	-0.382E 05	-0.189E 02	-0.736E 03
	1.3	-0.331E 02	-0.382E 05	-0.891E 02
3	10.0	-0.366E 05	0.201E 00	-0.653E 03
	1.3	-0.115E 02	-0.366E 05	-0.891E 02
4	14.0	-0.350E 05	0.156E 02	-0.659E 03
	1.3	0.317E 01	-0.350E 05	-0.891E 02
5	18.0	-0.333E 05	0.126E 02	-0.659E 03
	1.3	-0.434E 00	-0.334E 05	-0.890E 02
6	22.0	-0.317E 05	0.137E 02	-0.659E 03
	1.3	0.605E-01	-0.317E 05	-0.890E 02
7	26.0	-0.301E 05	0.144E 02	-0.659E 03
	1.3	0.409E-02	-0.301E 05	-0.889E 02
8	30.0	-0.285E 05	0.152E 02	-0.659E 03
	1.3	-0.396E-02	-0.285E 05	-0.888E 02
9	34.0	-0.268E 05	0.162E 02	-0.659E 03
	1.3	-0.136E-01	-0.269E 05	-0.887E 02
10	38.0	-0.252E 05	0.172E 02	-0.659E 03
	1.3	-0.315E-01	-0.252E 05	-0.887E 02
11	42.0	-0.236E 05	0.184E 02	-0.659E 03
	1.3	0.105E-01	-0.236E 05	-0.886E 02
12	46.0	-0.220E 05	0.199E 02	-0.659E 03
	1.3	0.110E 00	-0.220E 05	-0.884E 02
13	50.0	-0.203E 05	0.214E 02	-0.659E 03
	1.3	0.453E-01	-0.204E 05	-0.883E 02
14	54.0	-0.187E 05	0.231E 02	-0.659E 03
	1.3	-0.789E-01	-0.187E 05	-0.881E 02
15	58.0	-0.171E 05	0.253E 02	-0.659E 03
	1.3	-0.755E-01	-0.171E 05	-0.879E 02
16	62.0	-0.155E 05	0.282E 02	-0.660E 03
	1.3	0.158E 00	-0.155E 05	-0.877E 02
17	66.0	-0.138E 05	0.315E 02	-0.659E 03
	1.3	0.131E 00	-0.139E 05	-0.874E 02
18	70.0	-0.122E 05	0.354E 02	-0.660E 03
	1.3	-0.170E 00	-0.122E 05	-0.871E 02
19	74.0	-0.106E 05	0.410E 02	-0.660E 03
	1.3	0.134E-01	-0.106E 05	-0.866E 02
20	78.0	-0.896E 04	0.483E 02	-0.660E 03
	1.3	-0.459E-01	-0.900E 04	-0.860E 02
21	82.0	-0.733E 04	0.588E 02	-0.660E 03
	1.3	-0.192E 00	-0.739E 04	-0.850E 02
22	86.0	-0.570E 04	0.755E 02	-0.660E 03
	1.3	0.988E-01	-0.578E 04	-0.836E 02
23	90.0	-0.407E 04	0.105E 03	-0.661E 03
	1.3	0.383E 00	-0.418E 04	-0.811E 02
24	94.0	-0.244E 04	0.135E 03	-0.643E 03
	1.3	-0.249E 02	-0.260E 04	-0.761E 02
25	98.0	-0.814E 03	0.517E 03	-0.677E 03
	1.3	0.172E 03	-0.116E 04	-0.631E 02
26	2.0	-0.130E 05	0.110E 04	-0.133E 04
	3.8	0.976E 03	-0.131E 05	-0.848E 02
27	6.0	-0.127E 05	-0.448E 02	-0.126E 04
	3.8	-0.170E 03	-0.128E 05	-0.845E 02
28	10.0	-0.122E 05	0.156E 03	-0.134E 04
	3.8	0.103E 02	-0.123E 05	-0.839E 02
29	14.0	-0.117E 05	0.151E 03	-0.134E 04
	3.8	-0.417E 00	-0.118E 05	-0.837E 02
30	18.0	-0.111E 05	0.159E 03	-0.134E 04
	3.8	0.216E 00	-0.113E 05	-0.834E 02
31	22.0	-0.106E 05	0.166E 03	-0.134E 04
	3.8	-0.443E-01	-0.107E 05	-0.831E 02
32	26.0	-0.100E 05	0.175E 03	-0.134E 04
	3.8	0.321E-01	-0.102E 05	-0.827E 02
33	30.0	-0.949E 04	0.185E 03	-0.134E 04
	3.8	0.130E-01	-0.968E 04	-0.823E 02
34	34.0	-0.895E 04	0.195E 03	-0.134E 04
	3.8	-0.212E-01	-0.914E 04	-0.818E 02
35	38.0	-0.841E 04	0.207E 03	-0.134E 04
	3.8	-0.458E-01	-0.861E 04	-0.813E 02
36	42.0	-0.786E 04	0.221E 03	-0.134E 04
	3.8	-0.186E-01	-0.809E 04	-0.808E 02
37	46.0	-0.732E 04	0.236E 03	-0.134E 04
	3.8	-0.121E-03	-0.756E 04	-0.801E 02
38	50.0	-0.678E 04	0.254E 03	-0.134E 04
	3.8	-0.133E 00	-0.703E 04	-0.794E 02
39	54.0	-0.624E 04	0.274E 03	-0.134E 04
	3.8	-0.181E 00	-0.651E 04	-0.785E 02
40	58.0	-0.570E 04	0.298E 03	-0.134E 04
	3.8	-0.107E 00	-0.599E 04	-0.776E 02

41	62.0	-0.515E 04	0.326E 03	-0.134E 04
	3.8	-0.763E-01	-0.548E 04	-0.764E 02
42	66.0	-0.461E 04	0.360E 03	-0.134E 04
	3.8	-0.136E 00	-0.497E 04	-0.751E 02
43	70.0	-0.407E 04	0.400E 03	-0.134E 04
	3.8	-0.364E 00	-0.447E 04	-0.735E 02
44	74.0	-0.353E 04	0.450E 03	-0.134E 04
	3.8	-0.803E-01	-0.398E 04	-0.715E 02
45	78.0	-0.299E 04	0.512E 03	-0.134E 04
	3.8	0.464E-01	-0.350E 04	-0.692E 02
46	82.0	-0.244E 04	0.590E 03	-0.134E 04
	3.8	-0.722E-01	-0.303E 04	-0.663E 02
47	86.0	-0.190E 04	0.691E 03	-0.134E 04
	3.8	0.431E 00	-0.259E 04	-0.628E 02
48	90.0	-0.136E 04	0.820E 03	-0.134E 04
	3.8	-0.104E 01	-0.218E 04	-0.586E 02
49	94.0	-0.803E 03	0.100E 04	-0.136E 04
	3.8	-0.195E 02	-0.182E 04	-0.531E 02
50	98.0	-0.245E 03	0.128E 04	-0.132E 04
	3.8	0.140E 03	-0.139E 04	-0.492E 02
51	2.0	0.130E 05	0.131E 05	-0.133E 04
	6.3	-0.976E 03	-0.110E 04	-0.538E 01
52	6.0	0.127E 05	0.128E 05	-0.126E 04
	6.3	0.170E 03	0.448E 02	-0.569E 01
53	10.0	0.122E 05	0.123E 05	-0.134E 04
	6.3	-0.103E 02	-0.156E 03	-0.621E 01
54	14.0	0.117E 05	0.118E 05	-0.134E 04
	6.3	0.421E 00	-0.151E 03	-0.647E 01
55	18.0	0.111E 05	0.113E 05	-0.134E 04
	6.3	-0.217E 00	-0.159E 03	-0.677E 01
56	22.0	0.106E 05	0.107E 05	-0.134E 04
	6.3	0.635E-01	-0.166E 03	-0.711E 01
57	26.0	0.100E 05	0.102E 05	-0.134E 04
	6.3	0.173E-01	-0.175E 03	-0.747E 01
58	30.0	0.949E 04	0.968E 04	-0.134E 04
	6.3	0.502E-01	-0.185E 03	-0.788E 01
59	34.0	0.895E 04	0.914E 04	-0.134E 04
	6.3	-0.421E-01	-0.195E 03	-0.833E 01
60	38.0	0.841E 04	0.861E 04	-0.134E 04
	6.3	-0.991E-01	-0.208E 03	-0.884E 01
61	42.0	0.786E 04	0.809E 04	-0.134E 04
	6.3	0.200E-01	-0.221E 03	-0.940E 01
62	46.0	0.732E 04	0.756E 04	-0.134E 04
	6.3	0.994E-01	-0.236E 03	-0.100E 02
63	50.0	0.678E 04	0.703E 04	-0.134E 04
	6.3	-0.585E-01	-0.254E 03	-0.108E 02
64	54.0	0.624E 04	0.651E 04	-0.134E 04
	6.3	-0.110E 00	-0.275E 03	-0.116E 02
65	58.0	0.570E 04	0.599E 04	-0.134E 04
	6.3	-0.289E-02	-0.298E 03	-0.126E 02
66	62.0	0.515E 04	0.548E 04	-0.134E 04
	6.3	0.406E-02	-0.326E 03	-0.137E 02
67	66.0	0.461E 04	0.497E 04	-0.134E 04
	6.3	-0.202E 00	-0.360E 03	-0.151E 02
68	70.0	0.407E 04	0.447E 04	-0.134E 04
	6.3	-0.240E 00	-0.400E 03	-0.167E 02
69	74.0	0.353E 04	0.398E 04	-0.134E 04
	6.3	-0.582E-01	-0.450E 03	-0.186E 02
70	78.0	0.299E 04	0.350E 04	-0.134E 04
	6.3	-0.593E-01	-0.512E 03	-0.210E 02
71	82.0	0.244E 04	0.303E 04	-0.134E 04
	6.3	0.428E-01	-0.590E 03	-0.238E 02
72	86.0	0.190E 04	0.259E 04	-0.134E 04
	6.3	-0.411E 00	-0.691E 03	-0.274E 02
73	90.0	0.136E 04	0.218E 04	-0.134E 04
	6.3	0.980E 00	-0.820E 03	-0.316E 02
74	94.0	0.803E 03	0.182E 04	-0.136E 04
	6.3	0.194E 02	-0.100E 04	-0.370E 02
75	98.0	0.245E 03	0.139E 04	-0.132E 04
	6.3	-0.140E 03	-0.128E 04	-0.409E 02
76	2.0	0.399E 05	0.399E 05	-0.669E 03
	8.8	-0.206E 03	-0.217E 03	-0.957E 00
77	6.0	0.382E 05	0.382E 05	-0.736E 03
	8.8	0.331E 02	0.189E 02	-0.111E 01
78	10.0	0.366E 05	0.366E 05	-0.653E 03
	8.8	0.115E 02	-0.199E 00	-0.102E 01
79	14.0	0.350E 05	0.350E 05	-0.659E 03
	8.8	-0.317E 01	-0.156E 02	-0.108E 01
80	18.0	0.333E 05	0.334E 05	-0.659E 03
	8.8	0.434E 00	-0.126E 02	-0.113E 01
81	22.0	0.317E 05	0.317E 05	-0.659E 03
	8.8	-0.472E-01	-0.137E 02	-0.119E 01

82	26.0	0.301E 05	0.301E 05	-0.659E 03
	8.8	0.223E-01	-0.144E 02	-0.126E 01
83	30.0	0.285E 05	0.285E 05	-0.659E 03
	8.8	0.129E-01	-0.152E 02	-0.133E 01
84	34.0	0.268E 05	0.269E 05	-0.659E 03
	8.8	0.560E-01	-0.161E 02	-0.141E 01
85	38.0	0.252E 05	0.252E 05	-0.659E 03
	8.8	-0.170E-01	-0.172E 02	-0.150E 01
86	42.0	0.236E 05	0.236E 05	-0.659E 03
	8.8	-0.346E-01	-0.184E 02	-0.160E 01
87	46.0	0.220E 05	0.220E 05	-0.659E 03
	8.8	0.149E-01	-0.197E 02	-0.172E 01
88	50.0	0.203E 05	0.204E 05	-0.659E 03
	8.8	-0.193E-01	-0.214E 02	-0.186E 01
89	54.0	0.187E 05	0.187E 05	-0.659E 03
	8.8	-0.121E 00	-0.233E 02	-0.202E 01
90	58.0	0.171E 05	0.171E 05	-0.659E 03
	8.8	-0.199E-01	-0.254E 02	-0.221E 01
91	62.0	0.155E 05	0.155E 05	-0.659E 03
	8.8	0.863E-01	-0.280E 02	-0.244E 01
92	66.0	0.138E 05	0.139E 05	-0.660E 03
	8.8	-0.463E-02	-0.314E 02	-0.273E 01
93	70.0	0.122E 05	0.122E 05	-0.660E 03
	8.8	-0.450E-01	-0.356E 02	-0.309E 01
94	74.0	0.106E 05	0.106E 05	-0.659E 03
	8.8	-0.239E-01	-0.410E 02	-0.356E 01
95	78.0	0.896E 04	0.900E 04	-0.660E 03
	8.8	-0.360E-01	-0.484E 02	-0.420E 01
96	82.0	0.733E 04	0.739E 04	-0.660E 03
	8.8	-0.305E-01	-0.590E 02	-0.511E 01
97	86.0	0.570E 04	0.578E 04	-0.660E 03
	8.8	-0.105E 00	-0.756E 02	-0.653E 01
98	90.0	0.407E 04	0.418E 04	-0.661E 03
	8.8	-0.953E-01	-0.105E 03	-0.901E 01
99	94.0	0.244E 04	0.260E 04	-0.643E 03
	8.8	0.250E 02	-0.135E 03	-0.140E 02
100	98.0	0.814E 03	0.116E 04	-0.677E 03
	8.8	-0.172E 03	-0.516E 03	-0.270E 02

*
*

Listing of Program on WES Computer for Generating the Final Stress Data File

```
C
C       PROGRAM TO PRODUCE STRESS DATA
C
      CHARACTER NAME*6, FNAME*8
      LN = 10000
C
C       ATTACH INPUT STRESS DATA FILE
C
      PRINT, 'ENTER INPUT FILENAME'
      READ 100, NAME
  100 FORMAT (A6)
      ENCODE (FNAME,110) '/', NAME, ';'
  110 FORMAT (A1, A6, A1)
      CALL ATTACH(01, FNAME, 3, 0, IST)
C
C       ATTACH OUTPUT STRESS FILE
C
      PRINT, 'ENTER OUTPUT FILENAME'
      READ 100, NAME
      ENCODE (FNAME,110) '/', NAME, ';'
      CALL ATTACH(02, FNAME, 3, 0, IST)
C
C       ITY=TYPE(ITY=0 FOR STRESSES AT CENTROID)
C
      ITY = 0
C
C       ITC = 1 (POSITIVE STRESSES ARE TENSION)
C
      ITC = 1
C
      WRITE (2,120) LN, ITY, ITC
  120 FORMAT (3I5)
      LN = LN + 10
C
      PRINT, 'ENTER NUMBER OF ELEMENTS'
      READ 130, NEL
C
      DO 150 I = 1, NEL
      READ (1,130) IEL, XC, XSTR, XDUM, XYSTR
      READ (1,130) YC, YSTR
  130 FORMAT (V)
      WRITE (2,140) LN, XSTR, YSTR, XYSTR
  140 FORMAT (I5, 3E12.3)
  150 LN = LN + 10
C
      STOP
      END
```

*

Listing of Final Stress Data File FSTRF1

```
LIST FSTRF1

10000     0      1
10010   -0.399E 05   0.206E 03  -0.669E 03
10020   -0.382E 05  -0.331E 02  -0.736E 03
10030   -0.366E 05  -0.115E 02  -0.653E 03
10040   -0.350E 05   0.317E 01  -0.659E 03
10050   -0.333E 05  -0.434E 00  -0.659E 03
10060   -0.317E 05   0.605E-01  -0.659E 03
10070   -0.301E 05   0.409E-02  -0.659E 03
10080   -0.285E 05  -0.396E-02  -0.659E 03
10090   -0.268E 05  -0.136E-01  -0.659E 03
10100   -0.252E 05  -0.315E-01  -0.659E 03
10110   -0.236E 05   0.105E-01  -0.659E 03
10120   -0.220E 05   0.110E 00  -0.659E 03
10130   -0.203E 05   0.453E-01  -0.659E 03
10140   -0.187E 05  -0.789E-01  -0.659E 03
10150   -0.171E 05  -0.755E-01  -0.659E 03
10160   -0.155E 05   0.158E 00  -0.660E 03
10170   -0.138E 05   0.131E 00  -0.659E 03
10180   -0.122E 05  -0.170E 00  -0.660E 03
10190   -0.106E 05   0.134E-01  -0.660E 03
10200   -0.896E 04  -0.459E-01  -0.660E 03
10210   -0.733E 04  -0.192E 00  -0.660E 03
10220   -0.570E 04   0.988E-01  -0.660E 03
10230   -0.407E 04   0.383E 00  -0.661E 03
10240   -0.244E 04  -0.249E 02  -0.643E 03
10250   -0.814E 03   0.172E 03  -0.677E 03
10260   -0.130E 05   0.976E 03  -0.133E 04
10270   -0.127E 05  -0.170E 03  -0.126E 04
10280   -0.122E 05   0.103E 02  -0.134E 04
10290   -0.117E 05  -0.417E 00  -0.134E 04
10300   -0.111E 05   0.216E 00  -0.134E 04
10310   -0.106E 05  -0.443E-01  -0.134E 04
10320   -0.100E 05   0.321E-01  -0.134E 04
10330   -0.949E 04   0.130E-01  -0.134E 04
10340   -0.895E 04  -0.212E-01  -0.134E 04
10350   -0.841E 04  -0.458E-01  -0.134E 04
10360   -0.786E 04  -0.186E-01  -0.134E 04
10370   -0.732E 04  -0.121E-03  -0.134E 04
10380   -0.678E 04  -0.133E 00  -0.134E 04
10390   -0.624E 04  -0.181E 00  -0.134E 04
10400   -0.570E 04  -0.107E 00  -0.134E 04
10410   -0.515E 04  -0.763E-01  -0.134E 04
10420   -0.461E 04  -0.136E 00  -0.134E 04
10430   -0.407E 04  -0.364E 00  -0.134E 04
10440   -0.353E 04  -0.803E-01  -0.134E 04
10450   -0.299E 04   0.464E-01  -0.134E 04
10460   -0.244E 04  -0.722E-01  -0.134E 04
10470   -0.190E 04   0.431E 00  -0.134E 04
10480   -0.136E 04  -0.104E 01  -0.134E 04
10490   -0.803E 03  -0.195E 02  -0.136E 04
10500   -0.245E 03   0.140E 03  -0.132E 04
10510    0.130E 05  -0.976E 03  -0.133E 04
10520    0.127E 05   0.170E 03  -0.126E 04
10530    0.122E 05  -0.103E 02  -0.134E 04
10540    0.117E 05   0.421E 00  -0.134E 04
10550    0.111E 05  -0.217E 00  -0.134E 04
10560    0.106E 05   0.635E-01  -0.134E 04
10570    0.100E 05   0.173E-01  -0.134E 04
10580    0.949E 04   0.502E-01  -0.134E 04
10590    0.895E 04  -0.421E-01  -0.134E 04
10600    0.841E 04  -0.991E-01  -0.134E 04
10610    0.786E 04   0.200E-01  -0.134E 04
10620    0.732E 04   0.994E-01  -0.134E 04
10630    0.678E 04  -0.585E-01  -0.134E 04
10640    0.624E 04  -0.110E 00  -0.134E 04
10650    0.570E 04  -0.289E-02  -0.134E 04
10660    0.515E 04   0.406E-02  -0.134E 04
10670    0.461E 04  -0.202E 00  -0.134E 04
10680    0.407E 04  -0.240E 00  -0.134E 04
10690    0.353E 04  -0.582E-01  -0.134E 04
10700    0.299E 04  -0.593E-01  -0.134E 04
10710    0.244E 04   0.428E-01  -0.134E 04
10720    0.190E 04  -0.411E 00  -0.134E 04
10730    0.136E 04   0.980E 00  -0.134E 04
10740    0.803E 03   0.194E 02  -0.136E 04
10750    0.245E 03  -0.140E 03  -0.132E 04
10760    0.399E 05  -0.206E 03  -0.669E 03
10770    0.382E 05   0.331E 02  -0.736E 03
10780    0.366E 05   0.115E 02  -0.653E 03
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10790	0.350E 05	-0.317E 01	-0.659E 03
10800	0.333E 05	0.434E 00	-0.659E 03
10810	0.317E 05	-0.472E-01	-0.659E 03
10820	0.301E 05	0.223E-01	-0.659E 03
10830	0.285E 05	0.129E-01	-0.659E 03
10840	0.268E 05	0.560E-01	-0.659E 03
10850	0.252E 05	-0.170E-01	-0.659E 03
10860	0.236E 05	-0.346E-01	-0.659E 03
10870	0.220E 05	0.149E-01	-0.659E 03
10880	0.203E 05	-0.193E-01	-0.659E 03
10890	0.187E 05	-0.121E 00	-0.659E 03
10900	0.171E 05	-0.199E-01	-0.659E 03
10910	0.155E 05	0.863E-01	-0.659E 03
10920	0.138E 05	-0.463E-02	-0.660E 03
10930	0.122E 05	-0.450E-01	-0.660E 03
10940	0.106E 05	-0.239E-01	-0.659E 03
10950	0.896E 04	-0.360E-01	-0.660E 03
10960	0.733E 04	-0.305E-01	-0.660E 03
10970	0.570E 04	-0.105E 00	-0.660E 03
10980	0.407E 04	-0.953E-01	-0.661E 03
10990	0.244E 04	0.250E 02	-0.643E 03
11000	0.814E 03	-0.172E 03	-0.677E 03

Appendix B: Sample Run

1. The following problem is for the cross section of a lock wall. This same problem has been used in the WES report (in preparation) "Case Study of Six Major General-Purpose Finite Element Programs." The dimensions of the problem as well as contour plots of the stresses are given in that report. The cross section has only one material type. The purpose of the problem is to demonstrate the sequence of commands that might be used for a problem of this type.

2. Data files GEO and STRETM were created in the same manner as those described in Appendix A. The file GEO contains the necessary geometry (node and element) data and the file STRETM contains the stress data.

Defining files

```
ENTER GEOMETRY DATA FILE NAME:
=GEO

ENTER STRESS DATA FILE NAME:
=STRETM

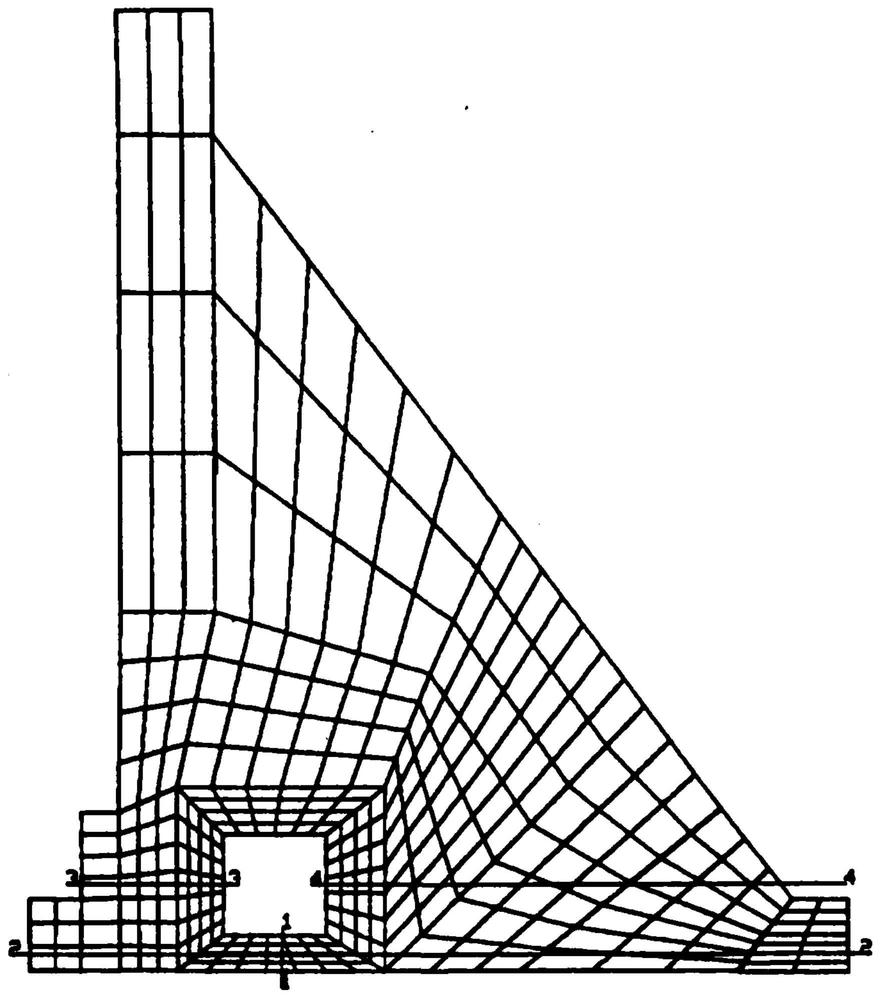
ENTER OUTPUT DATA FILE NAME:
=OUTEX
```

Command for plotting grid

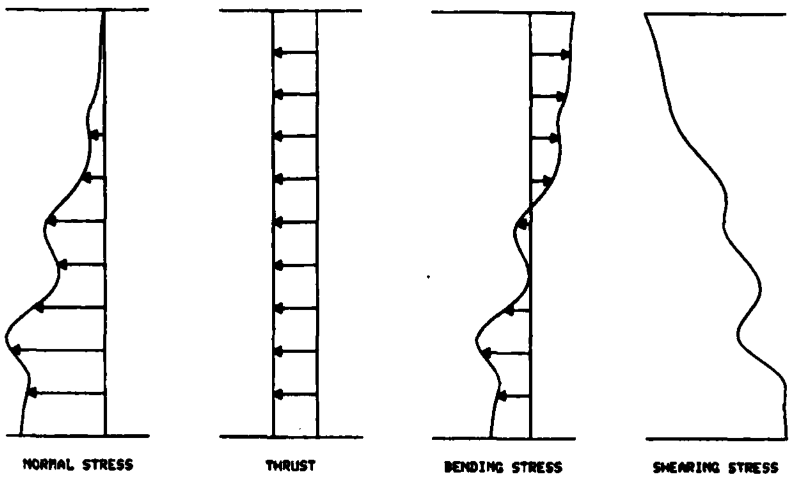
```
COMMAND?
=P G
```

Defining sections

COMMAND?	
• S 1	Section 1 (cross hairs used for section coordinates)
COMMAND?	
• S 2 1	Section 2: Consider only material type #1 (cross hairs used for section coordinates)
COMMAND?	
• S 3 5 12 27 12	Section 3: X1 = 18. Y1 = 12. X2 = 27. Y2 = 12.
COMMAND?	
• S 4 38 12 110 12 1	Section 4: X1 = 38. Y1 = 12. X2 = 50. Y2 = 12. Material Type = 1
COMMAND?	
• 0 1	



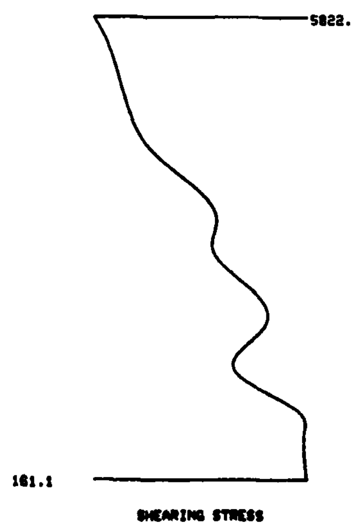
Output for section 1



(X1, Y1) = (33.87,-2.282)
(X2, Y2) = (34.08,6.131)
NEUTRAL AXIS = (34.,2.667)
SHEAR = .1599E+5
MOMENT = -.2697E+5
THRUST = -.2808E+5

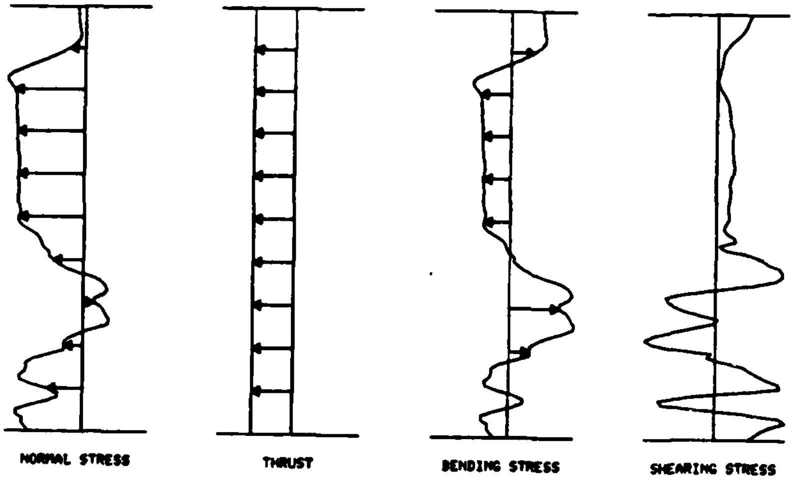
SECTION NO. 1

Output for shear section 1



SECTION NO. 1

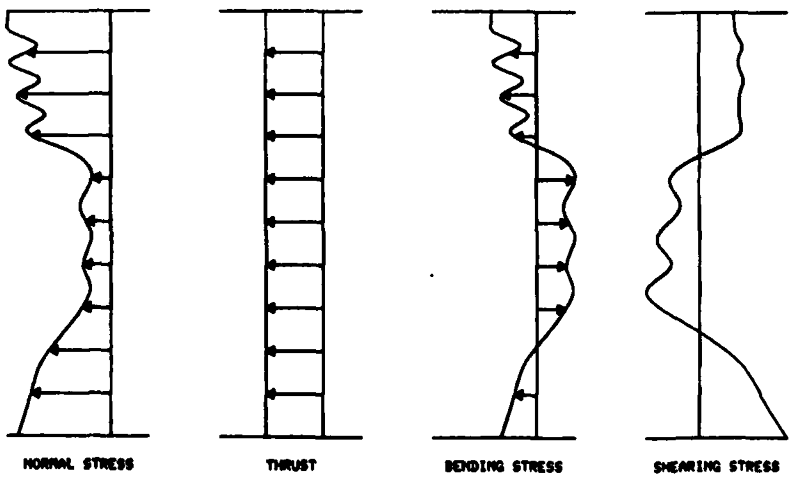
Output for section 2



(X1, Y1) = (-2.735,2.135)
(X2, Y2) = (112.1,2.345)
NEUTRAL AXIS = (96.2,2.316)
SHEAR = .1390E+6
MOMENT = .3473E+7
THRUST = -.9270E+6

SECTION NO. 2

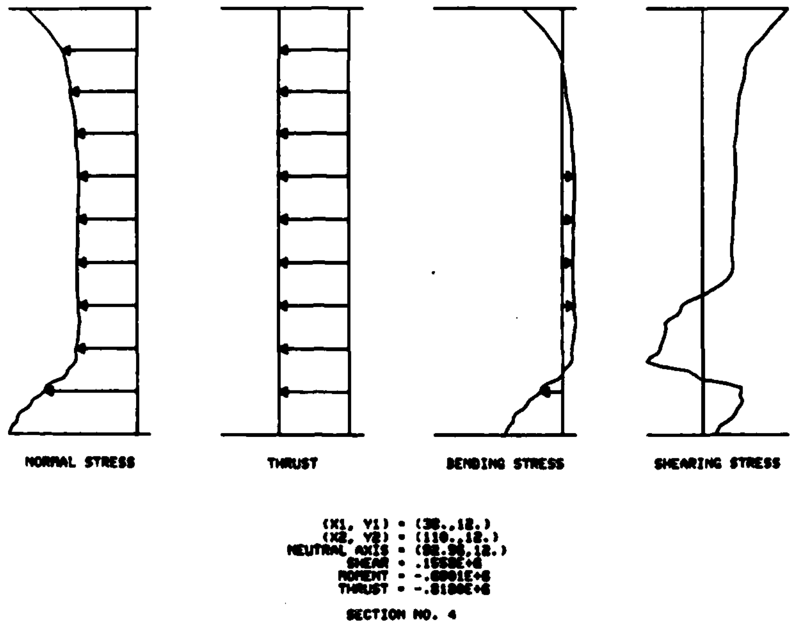
Output for section 3



(X1, Y1) = (5.,12.)
(X2, Y2) = (27.,12.)
NEUTRAL AXIS = (19.99,12.)
SHEAR = .2930E+5
MOMENT = .1737E+6
THRUST = -.2642E+6

SECTION NO. 3

Output for section 4



Output file

3. The following is the output file for this problem. It contains two lines of data for each section which has been displayed. The section number, X1, Y1, X2, Y2, and location of the neutral axis are given on the first line. The second line contains values for shear, moment, and thrust.

```
*LIST OUTEX
  1        33.87        -2.28        34.00        6.13        34.00        2.67
       0.159922E 06      -0.269741E 05      -0.280804E 05
  2        -2.74         2.13       112.14        2.35        96.20        2.32
       0.139042E 06       0.347851E 07      -0.926970E 06
  3         5.00        12.00        27.00       12.00        19.99       12.00
       0.293192E 06       0.173700E 06      -0.264195E 06
  4        38.00        12.00       110.00       12.00        92.96       12.00
       0.155849E 06      -0.690115E 06      -0.818045E 06

*
```

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

	Title	Date
Technical Report K-78-1	List of Computer Programs for Computer-Aided Structural Engineering	Feb 1978
Instruction Report O-79-2	User's Guide: Computer Program with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Mar 1979
Technical Report K-80-1	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report K-80-2	Evaluation of Computer Programs for the Design/Analysis of Highway and Railway Bridges	Jan 1980
Instruction Report K-80-1	User's Guide: Computer Program for Design/Review of Curvilinear Conduits/Culverts (CURCON)	Feb 1980
Instruction Report K-80-3	A Three-Dimensional Finite Element Data Edit Program	Mar 1980
Instruction Report K-80-4	A Three-Dimensional Stability Analysis/Design Program (3DSAD)	
	Report 1: General Geometry Module	Jun 1980
	Report 3: General Analysis Module (CGAM)	Jun 1982
	Report 4: Special-Purpose Modules for Dams (CDAMS)	Aug 1983
Instruction Report K-80-6	Basic User's Guide: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Instruction Report K-80-7	User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Technical Report K-80-4	Documentation of Finite Element Analyses	
	Report 1: Longview Outlet Works Conduit	Dec 1980
	Report 2: Anchored Wall Monolith, Bay Springs Lock	Dec 1980
Technical Report K-80-5	Basic Pile Group Behavior	Dec 1980
Instruction Report K-81-2	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL)	
	Report 1: Computational Processes	Feb 1981
	Report 2: Interactive Graphics Options	Mar 1981
Instruction Report K-81-3	Validation Report: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Feb 1981
Instruction Report K-81-4	User's Guide: Computer Program for Design and Analysis of Cast-in-Place Tunnel Linings (NEWTUN)	Mar 1981
Instruction Report K-81-6	User's Guide: Computer Program for Optimum Nonlinear Dynamic Design of Reinforced Concrete Slabs Under Blast Loading (CBARCS)	Mar 1981
Instruction Report K-81-7	User's Guide: Computer Program for Design or Investigation of Orthogonal Culverts (CORTCUL)	Mar 1981
Instruction Report K-81-9	User's Guide: Computer Program for Three-Dimensional Analysis of Building Systems (CTABS80)	Aug 1981
Technical Report K-81-2	Theoretical Basis for CTABS80: A Computer Program for Three-Dimensional Analysis of Building Systems	Sep 1981
Instruction Report K-82-6	User's Guide: Computer Program for Analysis of Beam-Column Structures with Nonlinear Supports (CBEAMC)	Jun 1982
Instruction Report K-82-7	User's Guide: Computer Program for Bearing Capacity Analysis of Shallow Foundations (CBEAR)	Jun 1982

(Continued)

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

(Concluded)

	Title	Date
Instruction Report K-83-1	User's Guide: Computer Program With Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Jan 1983
Instruction Report K-83-2	User's Guide: Computer Program for Generation of Engineering Geometry (SKETCH)	Jun 1983
Instruction Report K-83-5	User's Guide: Computer Program to Calculate Shear, Moment, and Thrust (CSMT) from Stress Results of a Two-Dimensional Finite Element Analysis	Jul 1983
Technical Report K-83-1	Basic Pile Group Behavior	Sep 1983
Technical Report K-83-3	Reference Manual: Computer Graphics Program for Generation of Engineering Geometry (SKETCH)	Sep 1983
Technical Report K-83-4	Case Study of Six Major General-Purpose Finite Element Programs	Oct 1983

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